

THE STRUCTURE OF DEMAND FOR FOOD IN BRAZIL

By

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A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1996

ACKNOWLEDGMENTS

I would like to express my gratitude to the committee chair, Dr. James L. Seale, Jr., for providing me with professional know-how and guidance; his comments and suggestions have helped me shape the dissertation. I would like to thank the cochair of the committee, Dr. Thomas S. Spreen, and the committee members, Drs. Timothy Taylor, Garry Fairchild and Mark T. Brown, for their support. In particular I would like to acknowledge with sincere thanks the reviews and comments provided by Dr. Thomas S. Spreen, my gratitude to Dr. Charles Moss who kindly offered many useful suggestions and to Dr. Henri Theil for the valuable insights I received during his seminars at the Department.

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Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy

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May, 1996

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The structure of demand for food in Brazil was analyzed using the Florida-Slutsky model. The model is a system of demand equations aimed to explain consumers' decision to allocate their expenditure on food groups simultaneously. The concept of conditional demand equations was used. The budget share of food groups was specified as functions expenditure on food and relative prices. Food groups were defined as narrow aggregates: wheat, pasta and bread; rice beans and manioc; beef; poultry, pork and fish; fruit and vegetables; other food and beverages; and prepared food and

food away from home. The model was fitted to a cross-section of 13,485 Brazilian households in 11 regions of the country. The regions of the country were considered separately. Data used were extracted from a Brazilian household survey (POF) carried out by the Brazilian Institute of Geography and Statistics (IBGE) in 1987/88.

The Florida-Slutsky model is linear in the logarithm of income, has quadratic pure price terms and linear Slutsky price coefficients. Maximum likelihood was used to estimate the model. Parameter estimates were used to calculate income and price elasticities at various levels of income for each of the 11 regions of the country. All calculated income elasticities decline with the level of income. The results confirm previous findings that food is a normal good. Nonetheless, there are significant differences in income and price elasticities among the food groups. Differences in elasticities across regions of the country suggest that although elasticities for Brazil can be calculated from regional elasticities, observed regional differences in consumption patterns should be considered in the analysis of demand for food goods at a low level of aggregation.

The main findings of this study were: 1) All seven food groups analysed are normal goods, 2) conditional on food expenditure, staples exhibit smaller income elasticities

than the other food groups, 3) the own-price elasticities of demand for all seven goods are small, and 4) the cross-price elasticities of demand are equal to one-fifth the own-price elasticities, on average.

CHAPTER 1

INTRODUCTION

One-third of Brazilian national income is spent on food, or approximately US\$ 150 billion (IBGE, 1993). Brazil is the largest country in South America and the second largest in the Western Hemisphere. The country comprises half of South America, both in terms of area and population. Its land area is approximately 3.3 million square miles. In 1993, the population of Brazil was 151.6 million, and per capita income was approximately US\$ 3,000.00 (Brazilian Institute of Geography and Statistics - IBGE, 1993). Following three decades of high income growth - an average of approximately 6% a year, between 1950-80 - the Brazilian economy entered a period of economic stagnation coupled with high inflation (Bresser Pereira, 1984, 1991). The 1980s are referred to as the *lost decade* - an allusion mainly to the lack of growth in per capita income for an entire decade (Coes, 1995). Following the trade liberalization and privatization reforms of the early 1990's, the set of policies contained in the *Real*

Plan of 1994, intended to generate price stability, were well received by the population and the business community (Coes, 1995). The stabilization plan is showing early signs of success, and its ultimate goal of creating a stable economic environment is becoming a likely scenario; the economy may be entering a period of high product and income growth, with opportunities for trade and investment in various sectors (EIU, 1994).

Assuming the economy grows at a rate equal to its 1950-80 average¹, within 12 years, consumers in Brazil will be spending an additional 150 billion dollars on food, or twice as much what they spent in 1992. By the year 2000, 120 million metric tons of grains and cereals will be needed to provide the population (175 million people²) with minimum nutritional requirements (FAO and WHO, 1994). Considering the annual domestic production of cereals and grains was approximately 75 million metric tons in 1993 (IBGE, 1993), for nutritional requirements of the population to be met, domestic supply will have to grow 7% a year through the year 2000.

¹ Projected food demand is based on annual income growth of 5.6% compounded over 12 years, excluding population growth, which is not considered. The number of years necessary for food consumption to double is approximate to the nearest integer. Food consumption is assumed to grow with income (unitarian income elasticity of demand for food).

² Based on population growth of 2% a year.

Food supply and demand is a key issue, both from a market and a nutritional stand point. In the next section, a brief historical prospective of the dynamics of food consumption in Brazil is provided, with emphasis on how the post-war institutional and economic policy environment has impacted consumption of domestically produced and imported food in Brazil.

2.1 Historical Prospective

For the most part of the twentieth century, and until the 1960's, economic activity in Brazil was primarily centered around the production of traditional agricultural export products: coffee, cocoa, sugar, cotton and tobacco being the main export products (Baer, 1989). It is interesting to note that as recently as 1962, coffee exports accounted for 53% total exports receipts, down from 71.7% in the years of 1925/27 (Baer, 1989). Until the mid 1960's, agricultural exports accounted for over 90% of total exports (Graham et al., 1987). It was not until the mid 1970's that agricultural exports lost its dominant position to exports of manufactured products (Homem de Melo, 1978). The majority of the population lived in rural areas until the 1940's (IBGE, 1993); food consumption by the tiny urban population could be met by

small scale production of food, parallel to the main economic activity in large farms. (Homem de Melo, 1992). The industrialization movement initiated in the 1940's had a profound impact on the economic structure of Brazil (Baer, 1989). It consisted of a set of economic policies designed to promote the industrialization of the country (Baer, 1972). Three periods of the industrialization movement can be distinguished according to the main orientation of the economic policy: *import substitution (1950-67)*, *export promotion (1968-90)* (Graham et al., 1987), and the *post-1990 market oriented policy reforms* (Coes, 1995).

Although industry was the major concern of economic policy throughout those periods, changes in the institutional and economic policy environment had a great impact on agriculture (Graham et al., 1987). Most of the literature on the impact of economic (industrialization) policies on agriculture is related to the supply side; they emphasize how policy options have affected crop selection (traditional export crops, new export crops, and products for the domestic market), agricultural growth, and productivity. Much less attention has been given to the demand side of Brazilian agriculture, in particular to the domestic component of this demand, consisting mainly of the demand for food.^{3,4} The first

³ Two studies (Mendonca de Barros and Graham, 1983; Homem de Melo, 1978) aimed at discussing the dynamics of food

noticable impact of the industrial expansion on agriculture was the rapid growth in the domestic demand for food, a result of rapid urbanization and growth of the urban middle class that started in the 1950's (Goodman et al., 1985).

The import-substitution industrialization movement was based at the outset on the use of multiple foreign exchange rates and direct controls over sales of foreign exchange intended to discourage imports of consumer goods compared to capital goods and intermediate products (Baer, 1972). In the 1950's, the multiple exchange rate system was also used to discourage food imports. Higher exchange rates were applied to food imports compared to non-food imports (Nicholls, 1972).

production in relation to export agriculture, refer to the importance of food measured by the large share of food on total expenditure. The evolution of food prices relative to non-food prices was even taken as a measure of income distribution (Homem de Melo, 1978).

⁴ Food production in Brazil is discussed in several studies related to the supply side of Brazilian agriculture (Mendonca de Barros and Graham, 1978; Homem de Melo, 1983) in the context of supply price response (Pastore, 1973), agricultural development (Schuh, 1970; Nicholls, 1969, 1971), agricultural policy (Smith, 1969; Paiva et al. 1973; Paiva 1975; World Bank, 1982), import substitution industrialization policy (Baer, 1989), export promotion policies (Baer, 1989; Homem de Melo, 1983), agricultural research (Schuh, 1972; Pastore and Alves, 1979; Silva, 1980; Homem de Melo, 1980; Ruttan, 1984), and land reform (Cline, 1970). Much less attention has been given to consumption of food from the demand side. Gray (1982) and Musgrove (1986) used cross-section data from an old household expenditure survey (IBGE/ENDEF, 1979) to fit an Engel curve; Strauss and Barbosa (1992) used the same data to estimate income and price elasticities for selected food goods.

Considering the import protection mechanisms in place, it appeared that expanded agricultural supply matched the growing demand for food in the 1950's⁵ (Goodman et al., 1985); no significant pressure on food prices was perceived (Barros and Graham, 1978). During shortages, the government would import basic commodities (Blumenschein, 1984).

Following the unification of exchange rates in the mid-1960s, the government began to use quotas and direct import controls to discourage imports of products that could be domestically produced (Baer, 1989). The composition of imports changed significantly throughout the import-substitution industrialization years. Imports of manufactured goods declined, as opposed to imports of fuel and capital goods which increased (Baer, 1989). It is interesting to note that food, beverage and tobacco imports as a share of total imports did not decline significantly, remaining constant at about 14.5% of total imports until the end of the 1960's (Baer, 1989). A steady decline was observed thereafter.

The 1960s marked a gradual transition from the inward-oriented (*import substitution*) to an outward-oriented (*export*

⁵ During this period, growth in the production of food crops was accomplished by increases in crop production areas. Since new lands brought into production used the same technology, no significant productivity gain was accomplished (Paiva, 1973). Between 1955 and 1965, the average growth in cultivated area was: 6.5% for rice, 4.7% for manioc and 4.2% for black beans (World Bank, 1982).

promotion) policy regime (Graham et al., 1987). The exchange rate was adjusted in favor of (agricultural) exports (Fishlow, 1974; Balassa, 1979). Cheap rural credit combined with a wide array of subsidies and tax credits were put in place aimed at promoting exports (Pastore, 1978; World Bank, 1982). The main result of the export oriented effort on agriculture was to promote expansion of the new export crops: soybeans (raw and processed), oranges (frozen concentrate), and import substitution crops such as sugar cane to be used in ethanol production (Graham et al., 1987). For a discussion about the impact of the growth in production of export crops over food production, see Mendonca de Barros and Graham (1979) and Homem de Melo (1983).

The average rates of growth of the production of export crops were substantially higher than comparable rates for food crops (Table 1.1). Paiva (1973) and *Conjuntura Economica* (various issues) refer to a mounting pressure on food prices starting in the 1970's, with special mention to 1983, when food prices increased by 237% compared to a 199% increase in the consumer price index. It is interesting to note that to deal with the problem of food price increases, the option to import was not even considered as an alternative to price controls, which were widely used in the 1970's and 1980's by the Brazilian government. Import restrictions were justified

Table 1.1: Brazil, Rates of Growth in Output
of selected Agricultural Products
1950-80

Crop	Percentual Rates of Growth in Production
Soybeans	20.76
Oranges	7.27
Wheat	5.62
Sugar	4.57
Tobacco	4.20
Corn	4.14
Rice	3.81
Manioc	2.81
Cacao	2.52
Beans	2.18
Coffee	1.92
Cotton	1.71

Source: IBGE, Estatísticas da Produção
Agrícola, 1991.

based on the arguments that food imports would have a negative impact on the balance of payments, and no country would be willing to rely on food imports for security reasons (Mendonca de Barros and Graham, 1979). Wheat and beef were the major import products during that period. A quick inspection of Figures 1.1 and 1.2 shows that there might be different reasons for Brazil to import these products; wheat imports were complimentary to the wheat import substitution program, while beef imports occurred foremostly during stabilization plans, when prices were frozen, and the government had to rely on imports to guarantee short term supply.

The oil shock of the early 1970's marked the beginning of severe pressures over the balance of payments that would persist throughout the 1980's. The situation was aggravated with the second oil shock. Soon afterwards the Brazilian economy entered a decade of economic stagnation and high inflation (Mendonca de Barros and Graham, 1979). The main reason for the economic stagnation of the 1980's was the decline in aggregate investment. A decline in capital inflow associated with higher interest rates on existing and new debt raised the cost of investment⁶. Facing a large balance of

⁶ The public sector investment increased during the first years, soon to contribute to larger fiscal deficits, that had to be covered by monetization with inflationary impacts. During the decade, inflation followed an upward trend,

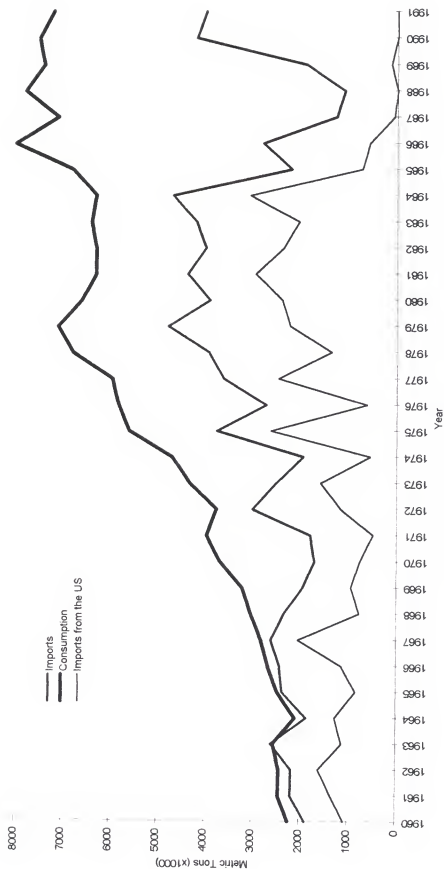


Figure 1.1 Brazil, Wheat Consumption, Imports and Imports from the U.S.
Source: USDA/ERS, 1994



Figure 1.2 Brazil, Beef Consumption and Imports
Source USDA/ERS, 1994

payment deficit, new incentives and subsidies were offered to the exporters, at the same time new restrictions were placed on imports. As a result, food imports continued to decrease as a proportion of total imports. By the end of the 1980's, food imports were negligible, accounting for less than 1% of total imports (FAO, 1994).

Observing the Brazilian economy in the early 1990's, one had the impression that economic agents were exhausted from price controls, government intervention, and trade restrictions. This is not a surprising fact, especially after four failed attempts at "economic plans" to stabilize the economy in the late 1980's and early 1990's (Coes, 1995). Different than its predecessors, the Real Plan of 1994 did not rely on price control mechanisms, instead an exchange rate anchor was aimed at accomplishing price stability. Trade liberalization and tariff reductions were used as support policies. This set of economic policies marked a rupture with almost half a century of government intervention; it represents a radical move towards a market oriented economy. If the ongoing fiscal reform is effective in dealing with the problem of fiscal imbalances, the likelihood that a scenario combining long-lasting price stability and economic growth will prevail is increased. Coes (1995) argues similarly.

culminating with a very high inflation in the end of 1989 and beginning of 1990.

Aside from the macroeconomic performance of the economy, the market oriented economic policies of the 1990's will have pronounced sectoral effects. Given the extent of the recent economic reforms, analyzing the impact of such complex set of policies over the various sectors of the Brazilian economy is not an easy task. In terms of the agricultural sector, food supply and demand, and the export/import mix, are likely to be impacted in the short run by changes in relative prices, trade liberalization policies and by the new tariff regime. In the long run, changes in income, productivity and the institutional and economic policy environments will affect the dynamics of the agricultural sector and the structure of demand for food as well.

1.2 Problem Statement

In a rapidly changing economic environment, assessment of the food situation is a key element in policy making. Recent economic reforms are leading the country towards a market oriented economy, and consumer decisions will play an increasing role in the goods they purchase, whether domestically produced or imported. Increased price flexibility will also influence consumer decisions. Real income growth (especially for poorer households that spend a

large share of income on food) will allow consumers access to a wider variety of goods. A better understanding of the structure of the food sector will provide technical support to policy makers' decisions.

1.3 Research Objectives

The objective of this research is to study the structure of the demand for food in Brazil, with focus on disaggregated goods and the observed diversity of consumption patterns across regions of the country, and across households with different socioeconomic characteristics and levels of affluence.

1.4 Overview of the Dissertation

Chapter 2 provides a review of models used in demand analysis. In Chapter 3, the newly released data set from the latest Brazilian household survey is presented, along with a discussion about the data collection process and the sampling techniques used. A full description of variables is also provided. In Chapter 4, estimation procedures are described and the results analyzed. Chapter 5 presents a summary of the main findings of this study.

CHAPTER 2

MODEL SPECIFICATION AND SELECTION

The analysis of the structure of food demand in Brazil requires the specification and estimation of a demand model that, as defined by Barten (1993), indicates how consumers allocate their income over the purchase of various commodities. The choice of model has important implications for empirical analysis (Deaton and Muellbauer, 1980a). Criteria for model selection were summed up by Barten(1993, pp. 136)

in econometrics the ideal specification should be consistent with theory, easy to estimate and fit the data, which includes good predictive performance.

The various aspects related to the model selection problem can be found in Brown and Deaton (1972), Lluch and Powell (1975), Deaton and Muellbauer (1980b), Theil (1987), Blundell (1988),

and Barten (1993). This task is further complicated by the fact that no single model can claim absolute superiority over competing specifications. This is the reason why the choice of the model must be considered in terms of the objectives and constraints of the research. (Deaton and Muellbauer, 1980). In this chapter, the issue of model selection is explored, and justification for the adoption of a specific model to perform the analysis of food demand in Brazil is presented.

Microeconomic theory provides useful information for empirical implementation of demand models (Barten, 1993). Demand models differ basically on how theoretical prescriptions are translated into restrictions on the parameters of demand equations (Brown and Deaton, 1972). There are two main reasons why demand equations should be derived from theory, instead of being directly specified (Barten 1989): the number of free parameters in the system can be reduced by imposing restrictions that follow from theory, and to generate predictions that make sense from a theoretical point of view.

A system of demand equations that satisfy the constraints of demand theory can be specified in basically four different ways (Barten, 1993). As a matter of organization, after a review of the constraints on demand systems implied by theory is presented in section one, the

four alternative ways to derive a system of demand equations are presented. Section two presents a model that is derived from direct utility maximization subject to a budget constraint. Section three presents a model that is derived from the indirect utility function. Section four presents a model that is derived from the cost function. Section five presents a model that is derived from application of the differential approach. The main properties of each model are highlighted in terms of their appropriateness to this study. Section six presents a general formulation of the model to be used in this study.

2.1 Theoretical Considerations

This section presents the properties of demand equations arising from utility theory and the consumer's utility maximizing behavior. Detailed discussion on these topics can be found in (Deaton and Muellbauer, 1980b; Theil 1987; Barten, 1993). Consumer's preferences can be represented by a utility function that is a parametric representation of his preferences. The consumer is assumed to behave as to maximize total utility that is a function of the quantity of goods consumed subject to his budget constraint (Deaton and Muellbauer, 1980). The

maximization problem can be solved by setting up the Lagrangean function,

$$(2.1) \quad \text{MAX } L(q_1, q_2, \dots, q_n, \lambda) = U(q_1, q_2, \dots, q_n) - \lambda \left(\sum_{j=1}^n p_j q_j - m \right),$$

where $L(\cdot)$ and $U(\cdot)$ are the Lagrangean and utility functions, respectively, q_i and p_i represent the quantity and price of good i , respectively, m is nominal income, and λ is the Lagrangean multiplier. Solution of (2.1) yields a set of demand functions that expresses quantity demanded as a function of income and prices,

$$(2.2) \quad q_i = q_i(m, P),$$

where P is the vector of commodity prices.

Theoretical restrictions can be expressed either in terms of derivatives of demand functions, or in terms of elasticities which are the derivatives of the demand functions where arguments are expressed in logarithmic form (Barten, 1993, pp. 132). The latter is chosen for convenience. Write (2.2) in logarithmic differential form

$$(2.3) \quad d \ln q_i = \eta_i d \ln m + \sum_{j=1}^n \mu_{ij} d \ln p_j,$$

where η_i is the income elasticity and μ_{ij} are the uncompensated price elasticities. Frisch (1959) showed that income and price elasticities should satisfy a set of properties if they are to reflect utility-maximizing behavior:

$$(2.4) \quad \sum_{j=1}^n w_j \eta_j = 1 \quad (\text{Engel aggregation})$$

$$(2.5) \quad \sum_{j=1}^n w_i \mu_{ij} = -w_j \quad (\text{Cournot aggregation}),$$

where w_i is the budget share of good i . The Slutsky or compensated price elasticity,

$$(2.6) \quad \epsilon_{ij} = \mu_{ij} + \eta_i w_j,$$

which reflects the substitution effect of price changes holding utility constant, can be used to formulate other properties

$$(2.7) \quad \sum_{j=1}^n w_i \epsilon_{ij} = w_j \quad (\text{Slutsky aggregation}),$$

$$(2.8) \quad \sum_{j=1}^n \mu_{ij} = -\eta_i, \text{ and}$$

$$(2.9) \quad \sum_{j=1}^n \epsilon_{ij} = 0 \quad (\text{Homogeneity}),$$

$$(2.10) \quad w_i \epsilon_{ij} = w_j \epsilon_{ji} \text{ (Symmetry), and}$$

$$(2.11) \quad \sum_{j=1}^n \sum_{i=1}^n x_i w_j \epsilon_{ij} x_j < 0, \text{ for all } x_i \text{ and } x_j \text{ not constants}$$

(Negativity).

There is one additional property that does not follow from theory, but from a particular structure of preference ordering (preference independence is discussed in the Appendix A)

$$(2.12) \quad \epsilon_{ij} = \phi \eta_i (\delta_{ij} - \eta_i w_j), \quad i = j, \text{ and}$$

$$(2.13) \quad \epsilon_{ij} = -\phi \eta_i \eta_j w_j, \quad i \neq j,$$

(Preference Independence)

where δ_{ij} is a Kronecker delta.

2.2 Direct Specification of Demand Equations

Early research in demand analysis was carried out mainly through direct specification of demand equations. Demand theory played a relatively minor role in model specification and selection. Demand equations were specified in a way that variables of interest were included and others disregarded (Brown and Deaton, 1972). Demand parameters were estimated by

the application of ordinary least squares (OLS) to single equations, using cross-sectional or time-series data (Brown and Deaton 1972). The logarithmic demand system used by Stone (1954a) exemplifies the direct specification or *ad-hoc* approach to demand analysis. The model is

$$(2.14) \quad \log q_i = a_i + \eta_i \log \left(\frac{m}{P} \right) + \sum_{j=1}^n \epsilon_{ij} \log p_j,$$

where the quantity consumed of good i , q_i , is a function of a constant term a_i , real income (given by the nominal income, m divided by a price index P), and n goods prices p_j . The price index P is given by the sum of logarithm of prices p_j , weighted by expenditure shares $p_j q_j / m$. The coefficients η_i and ϵ_{ij} are, respectively, the income elasticity and Slutsky price elasticities.

Stone estimated (2.14) by applying OLS to each equation separately. To reduce the number of parameters to be estimated in (2.14), Stone used estimates of the income elasticities from cross-sectional data. Also, Slutsky cross-price elasticities for goods that appeared to not be close substitutes or complements were dropped (Stone, 1954b). Thus, because of the specification and procedures adopted to estimate (2.14), the parameter estimates did not satisfy

adding-up, homogeneity or symmetry. In a logarithmic demand system, theoretical restrictions, except homogeneity, depend on budget shares that are not constant, thus they can not be imposed over a wide interval. To satisfy those restrictions, constant elasticities require constant budget shares (Barten, 1993, pp. 139). Byron (1970) estimated a logarithmic system with adding-up, homogeneity and symmetry imposed at specific data points.

The logarithmic demand system has the advantage that the coefficients are themselves elasticities, therefore easy to interpret. The income coefficient for good i represents its income elasticity, being greater than 1 for luxury goods, between 0 and 1 for necessities, and less than 0 for inferior goods (Deaton and Muellbauer, 1980a). The system has the disadvantage that elasticities are constant and do not depend on the income level. Demand for luxury goods would increase as income increases to a point that consumption of a single good could exhaust the entire budget (Deaton and Muellbauer, 1980a).

2.3 Demand Systems Derived from Utility Maximization

The first approach to deriving a demand system from a direct specification of the utility function can be

illustrated by the Linear Expenditure System (LES), one of the first demand systems to incorporate theoretical restrictions (Pollack and Wales, 1969; Brown and Deaton, 1972). The LES, first estimated by Stone (1954b), has been widely applied using individual country data (Pollack and Wales, 1969; Yoshihara, 1969), or using cross-country data (Theil, 1971; Debreu, 1971; Gamalestos, 1970; Solari, 1971) among others). Following Theil's (1987) exposition, demand equations in the LES are derived from maximization of a utility function of the form proposed by Klein and Rubin (1948) and Geary (1950), known as the Klein-Rubin or Stone-Geary utility function,

$$(2.15) \quad U = \sum_{i=1}^n g_i \log(q_i h_i),$$

subject to a budget constraint, yielding a set of n demand equations,

$$(2.16) \quad q_i = h_i + \frac{g_i}{p_i} (m - \sum_{j=1}^n p_j h_j), \quad j=1, 2, \dots, n,$$

where g and h are constant parameters, q_i , p_i and m are quantity, price, and nominal income, respectively. Multiplying both sides of (2.16) by p_i gives

$$(2.17) \quad p_i q_i = p_i h_i + g_i (m - \sum_{j=1}^n p_j h_j), \quad j=1, 2, \dots, n.$$

which is the LES. Demand equations of the form (2.17) corresponding to the Klein-Rubin utility function satisfy adding-up, homogeneity, and symmetry (Stone, 1954b; Deaton and Muellbauer, 1980). Income elasticities are given by the ratio of the marginal share (constant in the LES) to the budget share. Given that budget shares for necessities are expected to fall, as income grows the corresponding income elasticity rises with income, indicating that the higher the income, proportionally more would be spent on necessities. This has been argued by Theil and Clements (1987) to be implausible behavior. Consumers preferences represented by the Klein-Rubin or Stone-Geary utility function are constrained to be additive. Additivity in the LES is part of the maintained hypothesis, thus it is not subject to testing, as stated by Christensen, Jorgensen and Lau (1975).

Demand functions can also be derived from other less restrictive specifications of the underlying utility function. For a presentation of several forms of utility functions, see Theil (1980). The main problem is that demand equations derived from direct specification of the utility function appear not to be empirically interesting (Barten, 1993).

2.4 Demand Systems Derived from the Indirect Utility Function

The second approach to deriving demand equations is to first specify an indirect utility function. An example was proposed by Christensen, Jorgensen and Lau (1975), which is quadratic in the logarithms of quantities consumed; it is called the *indirect translog utility function* and corresponds to the *direct translog utility function*. The former takes the form

$$(2.18) \quad u = \omega(x, p) = \alpha_0 + \sum_{k=1}^n \alpha_k \log \left(\frac{p_k}{m} \right) +$$

$$0.5 \sum_{k=1}^n \sum_{j=1}^n \beta_{kj} \log \left(\frac{p_k}{m} \right) \log \left(\frac{p_j}{m} \right),$$

where α and β are coefficients, p and m is the price vector and total expenditure, respectively. Demand functions can be derived from (2.18) by application of Roy's (1943) identity (Christensen, Jorgensen and Lau, 1975).

$$(2.19) \quad w_i = \frac{\beta_i + \sum_{j=1}^n \beta_{ij} \log \left(\frac{p_j}{m} \right)}{\sum_{k=1}^n \beta_k + \sum_{k=1}^n \sum_{j=1}^n \beta_{kj} \log \left(\frac{p_j}{m} \right)}$$

The translog class of utility functions is a second order Taylor series approximation of an underlying utility function (Christensen, Jorgensen and Lau, 1975). Although the translog approximation is an useful way to generate utility functions, as noted by Deaton and Muellbauer (1980, p.74), the resulting demand systems are complicated and clumsy to estimate. Referring to other disadvantages of the translog demand functions, others have pointed out that parameters β_i have no straightforward economic interpretation, and that the number of parameters to be estimated increases in the proportion to approximately the square of the number of goods. Other disadvantages of the translog demand system are that it is not possible to satisfy monotonicity of the indirect utility function with respect to income (increasing) and prices (decreasing) for all values of m and p . Negativity is not enforceable in all data points and separability may not be easily imposed (Barten, 1993). Also, the

translog utility functions are not capable of providing a second order approximation of an arbitrarily blockwise dependent utility function in any neighborhood of a given point (Theil, 1980, pp. 87).

2.5 Demand Systems Derived from the Cost Function

The third approach to deriving demand equations is from a cost function. This can be illustrated by the Almost Ideal Demand System (AIDS) model, proposed by Deaton and Muellbauer (1980b). The AIDS model is a first order approximation of a system of demand equations that possesses desirable aggregation properties and does not include additivity as part of the maintained hypothesis. Besides, it is simple to estimate (Deaton and Muellbauer 1980b). Demand equations in the AIDS model are derived using Shephard's Lemma (Shephard, 1953, 1970; Diewert 1974). Specify the cost function as

$$(2.20) \quad \log C(U, P) = a(P) + U b(P),$$

where

$$(2.21) \quad a(P) = \alpha_0 + \alpha_k \log p_k + \frac{1}{2} \sum_{k=1}^n \sum_{l=1}^n \beta'_{kl} \log p_{kl}, \text{ and}$$

$$(2.22) \quad b(P) = \beta_0 P^{\beta_k}.$$

Differentiating (2.22) with respect to prices, yields demand equations that express budget shares as functions of expenditure m and prices P

$$(2.23) \quad w_i = a_i + b_i \log\left(\frac{m}{P}\right) + \sum_{j=1}^n c_{ij} \log p_j,$$

where

$$(2.24) \log P = a_0 + \sum_{k=1}^n a_k \log p_k + \frac{1}{2} \sum_{k=1}^n \sum_{l=1}^n b_{kl} \log p_k \log p_l,$$

and

$$(2.25) \quad b_{ij} = b_{ji} - \frac{1}{2} (b_{ij}^* + b_{ji}^*).$$

Adding up requires that

$$(2.26) \quad \sum_{k=1}^n a_k = 1, \quad \sum_{k=1}^n b_k = 0, \text{ and } \sum_{k=1}^n b_{kl} = 0,$$

Homogeneity and symmetry can be made a testable hypothesis (Deaton and Muellbauer, 1980b). Adding-up, homogeneity, and symmetry restrictions are satisfied provided that

$$(2.27) \quad \sum_{l=1}^n b_{kl} = 0, \text{ and } b_{lk} = b_{kl}.$$

The AIDS model is highly non-linear in parameters. It is often estimated by substituting

$$(2.28) \quad \log P = \sum_{i=1}^n w_i \log p_i,$$

for (2.24). Using (2.28), the budget share equations become linear in the parameters, but two problems arise: the identity test is not satisfied by the price index; and w_i appears on both sides of the demand equation (Theil et al., 1989). Also, the Stone index (2.28) can change with changes in income holding prices constant, unless the income elasticity for good i is unitary. In the AIDS model, negativity is not satisfied at all data points and separability structures are not nested in the general specification (Barten, 1993).

2.6 Differential Systems of Demand Equations

The fourth alternative way to derive demand systems uses the differential approach to demand analysis (Theil, 1975-6; Barten 1977). This approach presented in Appendix A is used to derive a general differential demand system. The Rotterdam model developed by Barten (1964) and Theil (1965) is one of the most widely used parametrization of the general

differential demand system. Demand equations in the Rotterdam model are expressed in terms of differentials of logarithms,

$$(2.29) \quad w_i \, d\log q_i = \theta_i \, d\log Q + \sum_{j=1}^n \pi_{ij} \, d\log p_j,$$

$$(2.30) \quad w_i \, d\log q_i = \theta_i \, d\log Q + \phi \sum_{j=1}^n \theta_{ij} \, d\log \left(\frac{p_j}{P^*} \right),$$

$$\sum_{j=1}^n \theta_{ij} = \theta_i ,$$

where

$$(2.31) \quad d \log Q = \sum_{j=1}^n w_j \, d\log q_j.$$

is a Divisia volume index, defined as the sum of the logarithm of quantities weighted by their budget shares, and P^* is a Frisch price index defined as

$$(2.32) \quad d\log P^* = \sum_{j=1}^n \theta_j \, d\log p_j.$$

In (2.29) π_{ij} is equal to $\phi(\theta_{ij} - \theta_i\theta_j)$, where ϕ is the inverse of the elasticity of the marginal utility of income. Equations (2.29) and (2.30) are the i th equation of the absolute and relative price versions of the Rotterdam model, respectively. Parameters of the model can be related to restrictions expressed in elasticity form, equations (2.4)

through (2.11). Dividing both sides of (2.29) by w_i , and noting that

$$(2.33) \quad d\log m = \sum_{j=1}^n w_j d\log q_j + \sum w_j d\log p_j,$$

$$(2.34) \quad dQ = \sum_{j=1}^n w_j d\log q_j, \text{ and}$$

$$(2.35) \quad dP = \sum_{j=1}^n w_j d\log p_j.$$

Replacing dQ , yields

$$(2.36) \quad d\log q_i = \eta_i \left(d\log m - \sum_{j=1}^n w_j d\log p_j \right) + \sum_{j=1}^n \varepsilon_{ij} d\log p_j,$$

where $\theta_i = w_i \eta_i$, and $\pi_{ij} = w_i \varepsilon_{ij}$. It can be shown how the parameters of the Rotterdam model are related to the theoretical restrictions implied by utility maximization.

$$(2.37) \quad \sum_{i=1}^n \theta_i = 1,$$

$$(2.38) \quad \sum_{j=1}^n \pi_{ij} = 0, \text{ adding-up,}$$

$$(2.39) \quad \sum_{j=1}^n \pi_{ij} = 0, \text{ homogeneity,}$$

$$(2.40) \quad \pi_{ij} = \pi_{ji}, \text{ symmetry, and}$$

$$(2.41) \quad \sum_{j=1}^n \sum_{i=1}^n x_i \pi_{ij} x_j < 0, \quad x_i, x_j \text{ constants, negativity}$$

The ease of how linear restrictions may be imposed in the Rotterdam model may explain the popularity of the specification and its wide use as a model to test demand theory (Deaton and Muellbauer, 1980). Strong separability or preference independence can be imposed through restrictions on π_{ij} , such that

$$(2.42) \quad \begin{aligned} \pi_{ij} &= \phi \theta_i (1 - \theta_j), \quad i = j, \\ &= \phi \theta_i \theta_j, \quad i \neq j. \end{aligned}$$

It was shown by Barnett (1979) that the Rotterdam model is separable, a desirable property in applied demand analysis when the demand for groups of goods are analyzed. The parameter θ_i is equal to

$$(2.43) \quad \theta_i = w_i \eta_i = \frac{p_i q_i \delta \ln q_i}{m \delta \ln m} = p_i \frac{\delta q_i}{\delta m} = \frac{\delta(p_i q_i)}{\delta m}.$$

The marginal budget shares are assumed constant in the Rotterdam model, meaning that Engel curves are linear and that

the marginal budget share θ_i and the average budget share w_i will converge to higher values of m (Barten, 1989).

Another model in the differential class of demand systems (Barten, 1993) is the CBS model (Keller and Van Driel, 1985). In the Rotterdam model, the parameters θ_i and π_{ij} are assumed constant, although there is no *a priori* reason why they should be held constant (Lee, Brown and Seale, 1993). In this model the price coefficients, π_{ij} , are assumed constants, like in the Rotterdam model, but marginal expenditure shares are assumed equal to the marginal shares of the Working's (1943) model. Thus the CBS model is

$$(2.44) \quad w_i \operatorname{dlog} \left(\frac{q_i}{Q} \right) = \beta_i \operatorname{dlog} Q + \sum_{j=1}^n \pi_{ij} \operatorname{dlog} p_j,$$

where $\beta_i = w_i (\eta_i - 1)$, or $\beta_i = \theta_i - w_i$, and $\operatorname{dlog} Q$ is the volume index defined in (2.34). The dependent variables in the system sum to zero, thus adding-up requires that

$$(2.45) \quad \sum_{j=1}^n \beta_j = 0.$$

A positive β_i means that $\theta_i > w_i$, or an income elasticity larger than one (luxury good), a negative β_i means that $\theta_i < w_i$, an income elasticity smaller than one (normal or inferior

good). The CBS has the disadvantage that preference independence can not be specified in terms of constants (Barten, 1989, pp. 448).

2.7 Levels Versions of Demand Models

The Rotterdam and CBS models were presented in the first difference version above. The corresponding cross-section versions of the two models, and the levels version of the AIDS are (Barten, 1989)

$$(2.46) \quad w_i = a_i + \beta_i \log \left(\frac{m}{P} \right) + \sum_{j=1}^n \gamma_{ij} \log p_{ij},$$

(AIDS)

$$(2.47) \quad w_i \log q_i = a_i + \theta_i \log Q + \sum_{j=1}^n \pi_{ij} \log p_{ij},$$

(ROTTERDAM)

$$(2.48) \quad w_i (\log q_i - \log Q) = a_i + \beta_i \log Q + \sum_{j=1}^n \pi_{ij} \log p_j.$$

(CBS)

The problems with the three models as well as their limitations were discussed in Sections 2.5 and 2.6. In the next section, the model used to estimate the parameters of a system of demand equations is presented along with the model's main properties that justify its use in this study.

2.8 Two Versions of the Florida Model

A new model of demand was recently developed by Theil, Chung and Seale (1989) to be applied but not limited to the analysis of cross-country data. The Florida model is based on Working's (1943) model that has explanatory power (Barten, 1992) especially when applied to estimating food demand (Seale and Theil, 1986; Theil et al., 1989) and has been widely applied to the analysis of household data (Barten, 1993). The Florida model was named after the place where it was developed to differentiate it from the old cross-country model (Seale et al., 1991) developed by Theil, Suhm and Meisner (1980) and used by Theil and Suhm (1981) and Theil and Clements (1987). Two versions of the Florida model, the Florida-Slutsky and the Florida-PI model are presented below.

Starting from Working's (1943) model,

$$(2.49) \quad w^*_i = \alpha_i + \beta_i \log E,$$

w^*_i is the budget share of good i at geometric mean prices¹,
is equal to the expenditure on good i over total

¹ Let p_{ih} be the price paid for good i by household h . The price ratio p_{ih}/p_{jh} differs across households. To formulate Working's model with a fixed set of parameters α_i and β_i , a

expenditure, $w_i = p_i q_i / E$, and is a function of the log of total expenditure. Given that the sum of the budget shares, w_i 's, over all n goods equals to one, the right hand side of (2.49) has to add up to one, implying the following restrictions on parameters:

$$(2.50) \quad \sum_{i=1}^n \alpha_i = 1, \quad \text{and} \quad \sum_{i=1}^n \beta_i = 0.$$

The marginal share of good i , θ_i , can be found by multiplying both sides of (2.49) by E

$$(2.51) \quad Ew_i = E\alpha_i + \beta_i E \ln E.$$

Noting that $Ew_i = \sum_{i=1}^n p_i q_i$, and differentiating with respect to E , yielding

particular set of prices must be selected. The geometric mean prices given by

$$(2.50) \quad \log p^*_i = \frac{1}{N} \sum_{h=1}^H \log p_{ih},$$

is an optimal choice in the sense that the sum of squared differences between p^*_i and p_{ih} , $h = 1, 2, \dots, H$, takes the smallest possible value - *minimum distance property* (Theil et al., 1989, pp. 40).

$$(2.52) \quad q_i = \frac{dE_i}{dE} = \alpha_i + \beta_i (1 + \ln E) = w_i + \beta_i.$$

The marginal share in the Working's model exceeds the budget share by a positive or negative constant β_i . Income elasticities, η_i , are given by the ratio of the marginal share to the budget share (Theil et al., 1989). Using (2.52), the income elasticity for good i is given by

$$(2.53) \quad \eta_i = \frac{\theta_i}{w_i} = 1 + \frac{\beta_i}{w_i}.$$

The sign of β_i determines whether a good is a luxury good (the income elasticity of demand is greater than 1 and $\beta_i > 0$), a necessity (the income elasticity is less than 1 and $\beta_i < 0$), or has a unitarian income elasticity ($\beta_i = 0$).

The Working's (1943) model has been widely applied to cross-sectional studies using household budget data, where households are assumed to face the same set of prices (Deaton and Brown, 1972), and it fits well to household cross-sectional data (Barten, 1989, 1992) especially for food (Seale and Theil, 1986; Theil et al., 1989). However, there are situations where households do not face the same set of prices, for example, in less developed countries where larger price variation may be observed due to differences in

transportation costs and market imperfections among other reasons (Deaton, 1987). To account for the impact of prices on budget shares, the Working's model has to be transformed to incorporate prices. Let w_{ih} be the observed budget share of good i for household h . The subscripts h are dropped for convenience, and adding w_i to and subtracting w^*_i from both sides of (2.49) yields

$$(2.54) \quad w_i = \alpha_i + \beta_i \log Q + (w_i - w^*_i),$$

Next, the differential approach (Theil, 1975-6; Barten, 1977) is used to evaluate the difference between $(w_i - w^*_i)$, caused by a move from the geometric mean prices, p^*_i , to the observed prices, p_i , real income being fixed at the level Q . Total differentiation of the budget constraint,

$$(2.55) \quad w_i = \frac{p_i q_i}{m},$$

yields

$$(2.56) \quad dw_i = \frac{q_i}{m} dp_i + \frac{p_i}{m} dq_i - \frac{p_i q_i}{m^2} dm.$$

Rearranging terms,

$$(2.57) \quad dw_i = w_i d(\log p_i) - w_i d(\log q_i) + w_i d(\log m),$$

or

$$(2.58) \quad dw_i = w_i[d(\log p_i) - d(\log P)] + w_i d(\log q_i) -$$

$$w_i[d(\log m) - d(\log P)],$$

where $d(\log P) = \sum_{i=1}^n w_i d \log p_i$ is the Divisia price index, and $d(\log Q) = w_i[d(\log m) - d(\log P)]$ is the Divisia volume index (Appendix A, equation A.19). In (2.56) $d(\log Q)$ vanishes because real income is fixed at the level Q , so that (2.56) can be simplified to

$$(2.59) \quad dw_i = w_i[d(\log p_i) - d(\log P)] + w_i d(\log q_i).$$

The term $w_i d(\log q_i)$ is the independent variable in the differential equation system (Appendix A, equation A.19). The term $d(\log Q)$ vanishes so that (2.57) can be expressed in terms of prices only

$$(2.60) \quad dw_i = w_i[d(\log p_i) - d(\log P)] + \sum_{i=1}^n \pi_{ij} d(\log p_j).$$

Substituting (2.60) into (2.54) yields

$$(2.61) \quad w_i = \alpha_i + \beta_i \log Q + w_i d(\log p_i) + \sum_{i=1}^n \pi_{ij} Dp_j.$$

Interpreting $d(\log p_i)$ as $\log p_i - \log p^*_i$, where p^*_i , the geometric mean price of good i , is

$$(2.62) \quad \log p^*_i = \frac{1}{H} \sum_{h=1}^H \log p_{ih}.$$

Applying the mean value theorem of differential calculus (Theil et al., pp. 157), and replacing w_i with $w^*_i = \alpha_i + \beta_i q$ yields the Florida-Slutsky model

$$(2.63a) \quad w_i = (\alpha_i + \beta_i q) +$$

$$(2.63b) \quad (\alpha_i + \beta_i q) \left[\log \frac{p_i}{p^*_i} - \sum_{j=1}^n (\alpha_j + \beta_j q) \log \frac{p_j}{p^*_j} \right] +$$

$$(2.63c) \quad \sum_{j=1}^n \pi_{ij} \log \frac{p_j}{p^*_j},$$

The model is linear in the logarithm of income (2.63a), has a quadratic pure-price term (2.63b), and a linear substitution terms (2.63c). The second version of the model, the Florida-PI model, is a special case of the differential demand equations (2.59), when consumers utility can be represented by an additive utility function of the form

$$(2.64) \quad U = \sum_{i=1}^n u_i(q_i).$$

The marginal utility of good i does not depend on consumption of good j , $i \neq j$. The Hessian is diagonal given that the second order cross derivatives of the utility function equal zero, implying that the matrix of substitution terms θ_{ij} (Appendix, equation A.47) is diagonal, and that

$$(2.65) \quad \sum_{j=1}^n \theta_{ij} = \theta_i.$$

Thus, the matrix of Slutsky coefficients takes the form

$$(2.66) \quad \pi_{ij} = \phi \theta_i (1 - \theta_j) \text{ if } i = j, \text{ and}$$

$$(2.67) \quad \pi_{ij} = -\phi \theta_i \theta_j \text{ if } i \neq j.$$

The Florida model under preference independence (Florida-PI) model is, using $\theta_i = w_i^* + \beta_i$ and $w_i = a_i + \beta_i q$,

$$(2.68a) \quad w_{ih} = (\alpha_i + \beta_i q) +$$

$$(2.68b) \quad (\alpha_i + \beta_i q) \left[\log \frac{p_{ih}}{p_i^*} - \sum_{j=1}^n (\alpha_j + \beta_j q) \log \frac{p_j}{p_j^*} \right] +$$

$$(2.68c) \quad \phi (\alpha_i + \beta_i q) \left[\log \frac{p_i}{p_i^*} - \sum_{j=1}^n (\alpha_j + \beta_j q) \log \frac{p_j}{p_j^*} \right],$$

where $q^* = 1 + q$, and ϕ is the income flexibility (the inverse of income elasticity of the marginal utility of income) that is assumed constant in the Florida-PI model. The model is linear in the logarithm of income (2.68a), has a quadratic pure-price term (2.68b), and a substitution term that is cubic in the parameters (2.68c). At geometric mean prices, or when relative prices coincide, the Florida-PI model becomes the Working's model (Theil et. al., 1989). When consumers face different prices, the pure price term reflects the fact that for higher prices, the budget share of that good will be higher. The substitution term shows that for higher prices consumers will substitute away from that good. An interesting feature of the model is that at the expense of only one additional parameter, the PI assumption assures the knowledge of income and own-price elasticities.

2.9 Group, Unconditional and Conditional Demand Equations

The Preference Independence assumption can be extended to groups of goods. This is known as the Block Independence assumption, where the utility function is written in terms of G groups, and demand equations for groups of goods, as well as for individual goods can be specified (Theil, 1980). Demand

equations for individual goods can be specified either as unconditional or conditional on expenditure on the group. Under Block Independence, the utility function can be written as

$$(2.69) \quad U = \sum_{g=1}^G u_g^*(q_g^*),$$

where q_g^* is a vector of quantities of the goods that belong to group g . The marginal utility of a group depends only on consumption of the goods belonging to the group; the Hessian matrix is block diagonal (Theil et. al., 1989).

The differential demand equation (Appendix A, equation A.29) that expresses the budget share of good i as a function of total expenditure and relative prices is the unconditional demand equation

$$(2.70) \quad w_i \, d \log q_i = \theta_i \, d \log Q + \phi \sum_{j=1}^n \theta_{i,j} \, d \log \left(\frac{p_j}{p^*} \right).$$

The demand for a group under Block Independence is (Theil et al., 1989, pp. 132)

$$(2.71) \quad w_g \, d(\log Q_g) = \Theta_g \, d(\log Q) + \phi \, \Theta_g \, d \left(\log \frac{p_g^*}{p^*} \right),$$

where Θ_g is the marginal expenditure on group S_g

$$(2.72) \quad \Theta_g = \sum_{\substack{i=1 \\ i \in S_g}}^n \theta_i,$$

p_g^* is the Frisch price index of goods belonging to group g

$$(2.73) \quad d(\log p_g^*) = \sum_{\substack{i=1 \\ i \in S_g}}^n \frac{\theta_i}{\Theta_g} d(\log p_i),$$

and p^* is the Frisch price index of all goods

$$(2.74) \quad d(\log p^*) = \sum_{g=1}^G \theta_g d(\log p_g^*),$$

The demand for a group depends on real income (total expenditure) and the relative price of the group. The demand for good i belonging to group S_g , conditional on food expenditure becomes

$$(2.75) \quad w_i^* d(\log q_i) = \theta_i^* d(\log Q_g) + \phi_g \sum_{\substack{j=1 \\ j \in S_g}}^n \theta_{ij}^* d(\log [\frac{p_j}{p_g^*}]),$$

$$(2.75a) \quad \sum_{\substack{j=1 \\ j \in S_g}}^n \theta_{ij}^* = \theta_i^*,$$

$$(2.76) \quad w_{\cdot i}^* = \frac{w_i}{w_g},$$

$$(2.77) \quad \theta_{\cdot i}^* = \frac{\theta_i}{\theta_g}, \text{ and}$$

$$(2.78) \quad \phi_g = \frac{\phi \theta_g}{w_g}.$$

2.10 Conditional and Group Demand Equations of the Florida Model

The Florida-Slutsky model to be used to estimate demand for a good conditional on the expenditure on food is

$$(2.79a) \quad \frac{w_i}{w^F} = (\alpha_i + \beta_i q^F) +$$

$$(2.79b) \quad (\alpha_i + \beta_i q^F) \left[\log \frac{p_i}{p_{\cdot i}^*} - \sum_{\substack{j=1 \\ j \in S_F}}^n (\alpha_j + \beta_j q^F) \log \left[\frac{p_{jh}}{p_{\cdot j}^*} \right] + \right.$$

$$(2.79c) \quad \left. \sum_{\substack{j=1 \\ j \in S_F}}^n \pi_{\cdot j} \log \left[\frac{p_j}{p_{\cdot j}^*} \right] \right],$$

where S_F is food group, w_i and w^F are the budget share of the i th good and the food group for household h , respectively, q^F

is the real expenditure on food of household h , and p^*_i is the geometric mean price of good i ,

$$(2.80) \quad \log p^*_i = \frac{1}{H} \sum_{h=1}^H \log p_i.$$

The Florida-PI model may be used to estimate demand for food as a group under the assumption of preference independence and takes the form

$$(2.81) \quad w_{gh} = (\alpha_g + \beta_g q) +$$

$$(\alpha_g + \beta_g q) \left[\log \frac{p^*_{q_g}}{p^*} - \sum_{g=1}^G (\alpha_k + \beta_k q) \log \frac{p^*_{k_g}}{p^*} \right] +$$

$$\phi (\alpha_g + \beta_g q^*) \left[\log \frac{p^*_{q_g}}{p^*} - \sum_{g=1}^G (\alpha_k + \beta_k q^*) \log \frac{p^*_{k_g}}{p^*} \right],$$

where w_g is the budget share of group g for household h , p_g is the Frisch price index of group S_g (2.71), q is the log of total expenditure, q^* is one plus the log of total expenditure, and $p^*_{q_g}$ and p^* were defined in (2.73) and (2.74), respectively.

CHAPTER 3

DATA

This chapter provides a description of the data used in this research along with a discussion of the main problems related to manipulation and organization of the data sets used in the empirical analysis. This study is based on a cross-section of Brazilian households that are responsible for over 70% of the estimated 350 billion dollars aggregate private consumption of the country, equivalent to a average per capita yearly consumption of around US\$ 6,000.00 in 1993 (Brazilian Institute of Geography and Statistics - IBGE, 1993).

Information on expenditure and consumption of the households in the sample is available for over 200 goods, grouped into three broad categories: consumption goods, durable goods and capital expenditure. The consumption goods category comprises broad groups (food, housing, education, health, transportation, fuel and energy), each group contains information on a large number of individual

expenditure items. The food group, the focus of this research, is further subdivided into 59 goods for which information is available. As this microdata plays a major role in this study, a detailed discussion on the various aspects of the data set is provided. In Section 2, a description of the household expenditure survey is presented with details on how the survey was designed and the information collected. In Section 3, sampling aspects of the survey are discussed, namely sample design, selection procedures of households, and relationship between the sample and the population.

Definition of a household used in the survey is provided in Section 4, along with discussion of the main socioeconomic characteristics of the households that are important to perform this analysis. Technical definitions of expenditure are provided in Section 5 along with summary statistics of household expenditures and expenditure shares; technical definitions of relative prices are discussed in Section 6 along with summary statistics of prices of food goods.

The survey was conducted during a 12 month period, between 1987 and 1988, a period of relative high inflation in Brazil. Accordingly, inflation must be dealt with by deflating prices. The treatment of inflation is discussed

in Section 7. In Section 8 a discussion on technical aspects of data files is presented.

3.1 The Brazilian Household Expenditure Survey

The main data set contains information on a sample of Brazilian households from 11 metropolitan areas in various regions of the country (Table, 3.1). The Brazilian Household Expenditure Survey (HES) (POF/IBGE, 1992) was carried out by Brazilian Institute of Geography and Statistics (IBGE) during approximately 12 months, between March 1987 to February 1988. Results were made available in the early 1990's. Over 12000 households were interviewed during a two week period. The Survey was conducted with the main objective of updating the weights of the Brazilian consumer price index, calculated monthly by IBGE.

Participants in the survey represent a population in the surveyed areas of 34.7 million inhabitants in 8.0 million households, comprising 29.3% of the total population of the country and 43.5% of the total population living in urban areas of the country IBGE (1993)¹ (Table 3.2).

A member of the household was selected to provide

¹ Urban areas as defined by IBGE (1993) are towns with population higher than 5,000 people.

Table 3.1 Identification of the 11 Areas in the Brazilian Household Survey, POF 87/88: Code Number, Region of the Country and Area Name

CODE	REGION	AREA
1	East	RIO DE JANEIRO
2	South	PORTO ALEGRE
3	East	BELO HORIZONTE
4	Northeast	RECIFE
5	South	SAO PAULO
6	Cntral	DISTRITO FEDERAL
7	North	BELEM
8	Northeast	FORTALEZA
9	Northeast	SALVADOR
10	South	CURITIBA
11	Central	GOIANIA

Source: IBGE (1992)

Table 3.2 Population in each Area of the POF 87/88 as a percentage of Brazil's Total and Urban Population

AREA	TOTAL	URBAN
RIO DE JANEIRO	7.41	10.97
PORTO ALEGRE	1.81	2.67
BELO HORIZONTE	2.07	3.06
RECIFE	1.79	2.65
SAO PAULO	10.24	15.15
DISTRITO FEDERAL	0.96	0.87
BELEM	10.24	1.03
FORTALEZA	1.26	1.87
SALVADOR	1.43	2.11
CURITIBA	1.11	1.65
GOIANIA	0.59	1.42
TOTAL	29.37	43.45

Source: IBGE (1992a)

information about the household, and on expenditures and quantities consumed of various goods. For details regarding the Survey design and implementation, see IBGE (1992, Vols. 1-3). Food expenditures were calculated based on reported values for the two-week period, no beginning or end-of-period food stocks were considered IBGE (1992, Vol. 2). Identification of the 53 expenditure categories as defined by IBGE (1993) is presented in Table 3.3. Those categories comprises a larger number of goods. The food category comprises 59 goods, which are identified in Table 3.4.

3.2 Sampling Procedures

The construction of the sample followed a multi-stage, stratified probability design. The 11 areas were treated independently for the purpose of selecting the sampled households. A description of the sampling procedures can be found in IBGE (1992, Vol. 3). A summary of the procedures is presented below.

Each metropolitan area was divided into a number of geographically delimited sub-areas called sectors. A sector comprises a number of households having location as the common characteristic. The number of households in each sector is more or less arbitrary, depending primarily on the

Table 3.3 Identification of 54 expenditure groups
in the Brazilian Household Survey - POF 87/88:
Code Number and Item Name

CODE	CATEGORY
1	FOOD
2	RENT
3	TAXES
4	HOUSEKEEPING
5	JANITORIAL
6	FURNITURE
7	APPLIANCES
8	REPAIR/MAINTANANCE
9	MEN'S CLOTHING
10	WOMEN'S CLOTHING
11	CHILDREN'S CLOTHING
12	SHOES
13	JEWERY/BIJOUT.
14	FABRIC/ARMARINHO
15	TRANSPORTATION
16	GASOLINE
17	AUTOMOTIVE ALCOOHOL
18	VEHICLE MAINTENACE
19	TRAVEL
20	OTHERS
21	COSMETICS
22	SHAVING CREAM/SUN TUNER
23	TOILET PAPER
24	OTHERS
25	DRUGS
26	HEALTH INSURANCE
27	DENTAL CARE
28	PHYSICIANS
29	HOSPITAL
30	GLASSES/LENSES
31	OTHERS
32	FORMAL EDUCATION
33	OTHER COURSES
34	BOOKS/MAGAZINES
35	OTHER EDUCATION
36	TOYS/GAMES
37	RECORDS AND TAPES
38	OTHER LEISURE

(continued)

Table 3.3 Identification of 54 expenditure groups
in the Brazilian Household Survey - POF 87/88:
Code Number and Item Name

(continued from previous page)

38	TOBACCO
39	HAIR STYLING
40	NAIL STYLING
41	OTHER
42	FAMILY EVENTS
43	NOTARY
44	OTHER EXPENSES
45	TAXES
46	STATE FEES
47	ALIMONY
48	AUTOMOBILE
49	REAL STATE ACQUISITION
50	REAL STATE RENOVATION
51	LOANS
52	FINANCING
53	MORTGAGE

Source: IBGE (1992)

Table 3.4 Identification of 59 food goods in the
Brazilian Household Survey - POF 87/88: Code
Number and Item Name

CODE	ITEM NAME
1	RICE
2	EDIBLE BEANS
3	OTHER CEREALS
4	PASTA
5	WHEAT FLOUR
6	MANIOC FLOUR
7	OTHER FLOURS
8	POTATOES
9	CARROT
10	OTHER ROOTS
11	SUGAR
12	RAW SUGAR
13	OTHER SUGAR
14	TOMATO
15	ONION
16	LETTUCE
17	OTHER VEGETABLES
18	BANANA
19	ORANGE
20	APPLE
21	OTHER FRUIT
22	BEEF GRADE A
23	BEEF GRADE B
24	PORK
25	FROZEN MEAT/FISH
26	FRESH FISH
27	OTHER MEAT
28	POULTRY
29	EGGS
30	OTHER BIRDS
31	PASTERIZED MILK
32	POWERED MILK
33	CHEESE
34	OTHER DAIRY
35	BREAD
36	CRACKERS
37	OTHER BAKED
38	COOKING OIL

(continued)

Table 3.4 Identification of 59 food goods in the
Brazilian Household Survey - POF 87/88: Code
Number and Item Name

(continued from previous page)	
38	OLIVE OIL
39	OTHER COOKING OIL
40	COFFEE
41	SOFT DRINKS
42	BEER
43	OTHER BEVERAGES
44	SARDINE
45	OLIVES
46	CORNED BEEF
47	OTHER CANNED FOOD
48	TOMATO PASTA
49	MAIONESSE
50	SALT
51	OTHER SPICE
52	PREPARED FOOD
53	OTHER FOOD
54	MEALS AWAY FROM HOME
55	DRINKS AWAY FROM HOME
56	SANDWICHES AWAY FROM HOME
57	SOFT DRINKS AWAY FROM HOME
58	OTHER AWAY FROM HOME
59	

Source: IBGE (1992)

population density of the region. Information on population and household characteristics regarding households in all sectors was available from Census data (IBGE, 1980). Average household income for each sector was available from the National Survey on Households carried out every year by IBGE.

The second step was to select the sectors to be included in the survey. The average income of each sector was the variable used to determine the sectors as well as the number of sectors to be included in the sample. The number of sectors in each income class had to approximate the distribution of income of all households (IBGE, 1992, Vols. 1). The number of sectors to be included in each income class was determined by aiming to get a degree of accuracy of more than 95%, that the distribution of income based on the sample of sectors represent the distribution of income for the households. Once the number of sectors in each income class to be included in the sample was determined, random, independent drawing without replacement was carried out to pick the exact number of sectors. Procedures adopted to build a sample of sectors are documented in (IBGE, 1992, chapter 3, Section 2).

The next step was to select the households in each sector to participate in the survey. The optimal number of

households in each sector was determined to be 15, and equal for all sectors (IBGE, 1992). To account for eventual number of non-responses, the *expected* number of households to participate in the survey was increased to 19. A random independent drawing with no replacement was carried out to select the 19 households out of the total number of households in each sector.

Field work was carried out, a preparatory interview was done with all selected households; those households not fitted to participate² in the survey were single out. The final number of households *chosen* to participate was lower than the number of households selected. The final number of households *interviewed* was even lower than the number of participating households, due to technical and operational problems (technical and operational procedures described in IBGE, 1992, Vol. 2). The number of households in the sample, according to the *expected, selected, chosen* and *interviewed* for each area is presented in Table 3.5.

After the data were collected, a consistency check was applied to detect and correct for eventual mistakes. Questionnaires with minor mistakes were sent back to the household to be corrected; others with larger

² Households in which members were not available or were not willing to participate in the Survey.

Table 3.5 Area, Population, Total Number of Households and Total Number of Households Reporting Income in each Area of the POF 87/88 Survey.

AREA	EXPECTED	SELECTED	CHOSEN	INTERVIEW
RIO DE JANEIRO	1,215	1,623	1,412	1,310
PORTO ALEGRE	1,050	1,376	1,194	1,064
BELO HORIZONTE	1,065	1,371	1,220	1,074
RECIFE	1,230	1,580	1,425	1,353
SAO PAULO	1,485	1,905	1,734	1,464
DISTRITO FEDERAL	720	918	828	782
BELEM	960	1,222	1,113	1,023
FORTALEZA	1,530	2,010	1,784	1,726
SALVADOR	1,245	1,671	1,385	1,247
CURITIBA	1,215	1,588	1,392	1,291
GOIANIA	1,170	1,496	1,351	1,277
TOTAL	12,885	16,760	14,838	13,611

Source: IBGE (1992a)

inconsistencies were disregarded. It follows from the selection process, that each household in the sample represents a given number of households in the population through a factor proportional to the total number of households included in each sector. The sampling procedures adopted allowed for the calculation of expansion factors that measures how representative of the population is a household in a given area. The expansion factors were adjusted for population growth that occurred between 1980 (the last year for which Census based information on the number of households was available) and the middle date of the survey 15/10/88. Population growth and expansion factors are presented in Table 3.6.

3.3 Household Data

Consumption patterns are influenced by characteristics of the regions where households are located (e.g., climate and degree of urbanization). For example, northern states of the country are located in equatorial zones as opposed to southern states located in temperate zones (Theil and Finke, 1983). Socioeconomic characteristics of households (e.g., household size and education levels) are also known to influence consumption patterns (Pollack and Wales, 1980). In

Table 3.6 Population Growth and Expansion Factors for each Area in the POF 87/88 Survey

AREA	POP. GROWTH(1)	EXP. FACTORS(2)
RIO DE JANEIRO	8	1778
PORTO ALEGRE	21	533
BELO HORIZONTE	24	490
RECIFE	18	350
SAO PAULO	17	1957
DISTRITO FEDERAL	34	341
BELEM	29	155
FORTALEZA	8	191
SALVADOR	2	272
CURITIBA	25	251
GOIANIA	24	-

Source IBGE(1992)

(1) Estimated percentage population growth between 1980 and 10/15/87.

(2) Number of households in the area represented by one household in the sample.

terms of households characteristics, household size is one key variable determining the amount of food purchased (Deaton and Muellbauer, 1980). Other factors like, age, sex and the number of children in the household also influence the amount of food purchased (Pollack and Wales, 1980).

Socioeconomic characteristics of the households were used in this study as follows: household size was used to calculate per capita expenditure method of *scaling*)³, that is expenditure divided by the number of people in the household. Average household size for each region is presented in Table 3.7. Other socioeconomic characteristics of the households were used as regressors to calculate missing prices for the food groups. The discussion of this latter topic is postponed to Section 3.9.

3.4 Expenditure Data

The Brazilian HES survey accounted for expenditures at both the household and the individual levels. Expenditure at the household level included food, housekeeping expenditures and others associated to individuals living in the household. Expenditures at the individual level included

³ For a discussion on the method of *scaling*, and other methods of incorporating household characteristics into demand analysis, see Pollack and Wales (1980).

Table 3.7 Average Household Size in each Area of the POF 87/88 Survey

AREA	AVG. HOUSEHOLD SIZE
RIO DE JANEIRO	3.71
PORTO ALEGRE	3.52
BELO HORIZONTE	4.48
RECIFE	4.56
SAO PAULO	4.04
DISTRITO FEDERAL	4.36
BELEM	5.15
FORTALEZA	4.78
SALVADOR	4.51
CURITIBA	4.00
GOIANIA	4.18

Source: IBGE (1992a)

food away from home, transportation and tobacco.

In order to construct household budgets from information on expenditures collected through a two-week survey, a method to assign expenditures on a timely basis had to be applied. For example, expenditure on utilities referred to a monthly expenditure, whereas a purchase of an appliance referred to longer periods. For example, for utilities, a month expenditure was collected, for clothing, information on the last three months was collected and for durables, information on six month expenditure was collected. Average expenditure on goods in the food group for the 11 areas is presented in Table 3.8, along with national averages and standard deviations, which provides a measure of how average expenditures on food goods by region are distributed around the mean. Another important aspect of household expenditures is the percentage of households that reported purchases of food goods during the surveyed period (Table 3.9).

It is interesting to observe that household expenditure on food goods exhibits a lot of variation (Table 3.9) and confirms factual knowledge that there are substantial differences in household consumption patterns for various regions of the country. For example, data on Table 3.9 shows that expenditure on wheat is over ten times larger in

Table 3.8 Brazil Average Monthly Food Consumption per Household by Region, National Averages and Standard Deviation in C25

DOUGLAS	SÃO DE JANEIRO	PORTO ALERE	SÃO CARLOS	RECIFE	SÃO PAULO	SANTO PETER	SERGI	PORTO ALEGRE	SALVADOR	GOIÁS	GOIÁS	SÃO CARLOS	SÃO CARLOS
ALCOHOL	231.35	181.70	343.58	130.74	228.51	307.64	198.91	348.22	145.83	215.89	329.58	240.18	80.28
BEANS	118.04	69.89	194.50	201.88	145.51	148.87	195.41	306.17	206.02	74.88	125.90	162.72	88.59
O. CEREAL	17.19	22.88	24.38	22.37	29.59	26.29	144.40	9.73	34.41	32.74	42.07	36.89	38.70
PASTA	75.58	64.11	78.87	108.02	74.96	51.52	77.91	96.85	75.45	62.50	51.29	78.38	17.35
WHEAT	18.08	87.95	30.94	10.64	20.28	14.46	8.87	9.05	13.83	100.70	20.89	28.64	28.19
MILK	14.04	2.57	15.72	115.10	12.54	14.84	292.43	74.24	154.97	8.78	15.89	85.35	90.79
O. MILK	55.35	41.83	59.92	90.03	64.19	81.88	42.96	82.52	57.81	88.87	45.10	80.72	15.32
POTATO	69.00	77.91	87.69	28.64	81.57	45.16	33.87	22.20	29.31	81.00	44.08	49.11	19.19
CARROT	21.38	11.44	17.00	13.13	16.79	17.40	9.85	10.71	11.98	8.52	16.33	14.04	3.97
O. ROOTS	17.74	23.88	23.73	39.32	21.50	24.63	4.54	8.91	14.56	13.18	24.34	19.50	9.87
SUGAR	170.86	104.53	11.71	15.28	145.16	16.52	170.50	59.50	19.52	194.81	8.63	83.55	74.93
S. SUGAR	4.05	43.38	215.46	168.99	2.74	153.73	7.59	156.56	183.81	5.50	128.88	97.42	84.48
O. SUGAR	106.78	125.60	102.52	59.31	138.41	112.97	54.51	60.71	65.60	150.33	113.57	99.14	33.94
TOMATO	40.18	44.43	44.19	37.24	52.20	52.74	42.05	24.31	45.13	38.79	60.75	43.82	9.51
ONION	23.88	30.28	24.00	26.26	27.02	24.10	29.17	16.51	34.78	21.90	19.65	25.25	5.07
LITCHI	14.81	19.88	14.38	5.24	108.14	11.69	8.99	1.29	5.43	11.84	22.44	20.36	29.78
O. LITCHI	91.85	59.41	86.00	82.07	78.51	73.78	95.52	53.80	88.91	45.31	96.98	77.27	17.39
CANARY	78.91	45.18	82.52	88.73	124.83	88.33	100.20	94.40	78.88	50.34	74.86	80.41	22.80
GRANAR	93.80	33.78	78.70	56.45	86.19	95.07	47.82	55.98	52.29	59.30	69.40	64.83	16.75
APPLE	49.80	35.22	42.26	17.51	208.51	54.93	17.55	21.38	31.09	54.13	37.94	51.85	53.70
O. FRUIT	139.93	64.09	83.70	88.45	518.22	135.77	103.82	66.82	110.62	107.11	89.85	138.58	127.21
ORANGE	444.41	317.66	369.48	328.96	281.50	450.94	882.53	372.37	389.92	431.50	484.25	413.96	108.83
LEMON	175.88	508.85	220.12	236.81	98.94	359.26	796.95	241.78	479.85	282.25	236.90	330.49	197.31
PEACH	71.22	39.20	108.96	28.49	201.28	71.51	31.12	72.48	84.49	79.15	67.26	73.20	49.18
PEAR	206.31	145.08	112.84	259.07	85.30	131.43	244.37	53.48	325.83	153.19	95.30	164.74	84.12
PLUM	103.01	17.82	27.54	86.44	77.52	35.54	345.33	131.18	153.88	39.53	20.94	94.59	95.13
O. PEAR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
POPPLES	284.08	303.14	304.93	364.55	339.06	306.71	390.75	432.36	381.51	274.85	222.60	327.32	80.50
RAISIN	64.19	90.83	90.47	96.82	116.49	106.40	94.21	123.87	109.62	89.27	81.87	99.99	13.09
O. POPPLES	9.51	1.87	12.44	2.53	4.50	10.05	15.36	8.85	5.32	2.37	2.21	8.62	4.64
APPLE	459.24	530.91	411.86	105.85	963.91	514.87	23.07	228.80	207.77	446.60	370.01	380.52	198.18
PEAR	27.03	23.87	11.07	188.39	33.50	41.00	268.29	160.59	192.44	33.77	10.28	88.00	90.97
CHERRY	56.90	37.10	13.18	23.45	45.20	23.44	23.67	13.38	33.54	33.84	5.29	28.09	15.13
O. NUT	273.93	212.78	364.74	274.01	300.77	278.90	200.11	264.27	239.96	247.18	324.86	273.77	48.02
BRAND	366.58	293.87	300.46	488.79	384.29	345.99	513.78	484.11	568.30	284.86	229.97	382.02	110.20
CHOCOLATE	112.14	87.07	108.02	153.20	90.81	102.32	86.42	115.23	155.94	107.54	91.48	110.00	24.24
O. BRAND	86.37	112.31	77.73	73.00	94.59	82.95	33.39	48.83	123.29	88.38	68.03	80.96	25.51
COIL	83.03	81.28	122.04	57.62	102.17	118.98	87.44	69.09	71.84	95.52	134.62	93.07	24.28
GEWILL	18.44	1.10	8.99	3.18	9.52	5.30	3.08	1.18	10.47	1.28	2.26	5.89	5.45
TOILET	5.22	17.89	10.26	1.43	118.91	3.59	3.85	16.35	12.40	10.83	4.82	14.89	33.09
COFFEE	113.53	64.19	137.74	97.26	116.59	110.62	121.15	133.14	138.00	141.33	119.22	119.34	17.90
SOFT DRINK	114.93	105.86	93.26	81.10	52.59	85.88	97.77	70.21	68.98	118.55	94.04	87.53	21.88
BEER	44.75	85.85	70.50	41.09	69.53	42.39	32.43	22.13	66.38	41.23	69.25	51.41	17.31
O. BEER	64.77	157.34	60.73	71.44	14.72	71.31	49.52	81.70	107.81	94.94	62.26	74.21	38.32
SARDINE	8.78	8.63	8.64	10.33	12.78	8.40	15.32	16.64	4.44	9.87	5.70	9.98	3.70
OLIVE	8.85	1.89	9.87	3.14	1.85	9.83	4.56	2.13	2.76	4.23	8.18	4.99	3.17
CAN BEER	0.97	0.00	0.20	8.81	34.91	1.56	17.31	12.27	5.88	0.45	0.29	7.33	10.78
O. CANNED	25.72	25.85	21.52	8.80	29.89	20.78	17.81	10.38	14.49	29.54	13.33	19.81	7.43
TOILET PAPER	19.14	24.45	29.96	12.27	18.70	22.77	2.45	2.02	26.56	32.02	31.51	19.90	10.44
MAILED	15.98	10.12	14.14	6.41	14.89	14.14	5.73	7.44	7.95	13.95	9.85	10.95	3.76
SALT	17.46	13.37	20.33	12.18	90.84	12.83	12.81	15.87	12.56	16.34	15.95	21.81	22.97
O. SPICE	79.41	43.40	59.81	73.97	110.49	46.85	60.68	51.17	78.64	51.20	29.06	82.26	22.32
PREP. FOOD	48.83	85.92	53.56	31.60	4.10	57.87	78.71	49.10	43.87	88.65	48.91	51.89	22.57
O. P. FOOD	0.00	0.00	0.00	0.00	408.51	0.00	0.00	0.00	0.00	0.00	0.00	37.14	123.17
MEAT	328.65	446.05	375.48	287.81	881.26	315.12	318.82	444.87	476.92	281.00	364.47	145.30	72.86
SHRIMP	63.19	27.71	38.96	14.98	27.08	48.96	30.42	41.85	38.96	42.42	26.63	57.46	72.86
SAUSAGE	146.82	154.74	172.47	144.20	259.88	191.64	151.81	131.90	263.85	111.69	185.47	174.03	49.01
SOFT OUT	385.73	209.71	415.36	411.78	29.35	429.88	487.82	497.54	854.87	191.24	361.91	370.46	171.07
COFFEE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	5617.05	5434.28	5683.52	5464.52	6804.80	6383.21	7031.07	5813.06	6953.85	5514.72	5254.31	6032.22	2796.14

Source: IBGE, 1992

Curitiba than in Belem, and consumption of manioc is over 100 times larger in Belem than in Porto Alegre. The latter difference can be largely explained by the percentage of households that consume the product in each region, 11% in the region of Porto Alegre compared to 80% in the region of Belem.

3.5 Purchase Price Data

Information regarding expenditures on food and household items were recorded in a household expenditure book. The housewife or someone else was asked to report expenditure and the quantity of goods purchased during a two week period. Unit prices for items were latter calculated by dividing expenditures by the reported quantities (IBGE, 1992). Repeated purchases for items like bread and fresh milk are reported more than once. Expenditures and quantities consumed of goods in the same category were so that average purchase prices for the good could be calculated. A summary of average prices paid for goods in the food group are reported in Table (3.10), along with national averages and standard deviation.

It is interesting to observe the large dispersion of prices paid by households (Table 3.10). Higher prices in one

region compared to others may partially explain lower consumption and vice-versa. Relative rather than absolute prices across regions should be used to explain differences in household consumption (Theil et. al., 1989), because relative prices in a high price region for all goods could equal those in a low price region, leaving consumers with the same decision choice regarding prices. See Deaton and Muellbauer (1980) for a discussion on the problem of relative versus absolute price in consumers decision).

3.6 The Inflation Effect

Information on expenditure was collected during a period of 12 months, from March 1987 to February 1988, and this was a period of relatively high inflation in Brazil. If expenditures and prices collected at different times are to be made comparable, a strategy had to be adopted to bring expenditure and prices to a base period by way of a method to deflate expenditure and prices.

The method adopted by IBGE expenditures was to deflate expenditure information using the price variation for each good in that particular region of the country. The reference date was chosen as the middle date of the Survey period or 10/15/87. The information on prices was available

to IBGE from the consumer price index data bank (IBGE, 1992). Calculations were done by applying the variation in the price of the goods between the middle date of the period when the good was purchased and the reference date. For example, expenditure on a food good during the first two weeks of December 1987 was deflated by application of the price variation of that good, between December 7 and October 15, 1987. Detailed information on price variation for individual goods was taken from data collected for the purpose of calculating consumer price indices. To operationalize this method, a large number of deflators were used (Table 3.11).

3.7 Data Organization and Computer Files

Since the data set is extremely large, it is worthwhile for the sake of references to present technical aspects of the data files. The files were originally recorded in IBM format, 2400' reel tapes, from which information was transferred to CD ROMs. Totally, there are 11 files, one for each region, with the extension number of the file identifying the respective area. Each file contains all information relating to each household surveyed. Non responses are kept in blank spaces to differ from zero

Table 3.11 Number of deflators used for each type of expenditure

PERIOD	NUMBER OF GOODS	NUMBER OF DEFLATORS
6 months	267	1602
1 and 3 months	331	331
1 and 7 days	678	678
TOTAL	1276	2611

Source: IBGE (1992a)

quantity, price or expenditure, which are recorded as a dot. A print-out example of the data files is presented in Appendix B.

3.8 Commodity Aggregation

The Survey reported expenditure data for 53 groups that are further disaggregated yielding a much larger number of goods. Even considering only 59 goods in the food group, the number is still large to be treated in this analysis. A method that allows us to focus on the food group and to define how to aggregate goods is presented.

The assumption used in this study is that consumer preferences are separable into broad aggregates, so that for our purpose, it is assumed that the utility of consuming food is independent (preference independence) of the consumption of non-food.

Since we are not only interested in studying demand for food as a group but also demand for specific food goods, we have to define the groups. Household expenditure surveys typically carry information on a large number of individual goods. A practical solution to the problem involves dealing with the problem referred to by Brown and Deaton (1972) as aggregation over commodities. For our case, goods were aggregated in seven narrowly defined aggregates according to

the criteria that: i) each food item should be included in one and no more than one group; and ii) wheat based products and beef as well as their substitutes should be considered at a low level of aggregation. The groups are defined as: wheat group, other cereal, beef, other meat, fruit and vegetables, other food (including beverages), and food away from home. For the seven good aggregation model, average expenditures, budget shares and prices (unit values) are presented in Tables 3.12, 3.13 and 3.14, respectively.

3.9 The Non-Reported Consumption Problem

Households were asked to report purchases of goods during a two-week period as well as purchase of food away from home during a one-week period. This information was taken as a measure of household consumption for food consumed at home and away from home. No allowance was made for beginning or end-of-period stocks. Quite frequently, households reported zero purchase of goods during that period, because: i) the good was not purchased, or ii) the good was not consumed. Whether food was not purchased or not consumed has different implications for the analysis. The assumption adopted in this study is in line with the frequency of purchase problem (Heien and Wessels, 1988), so

Table 3.12 Average Expenditure on Food Groups, by Region, in CZ\$

	NO DE JANEIRO	PORTO ALEGRE	BELO HORIZONTE	RECIFE	SÃO PAULO	DISTRITO FEDERAL	BRASIL	FORTALEZA	SALVADOR	CURITIBA	GOIÂNIA	NAT. AVERAGE	STD DEV
Wheat, Pulse and Bean	660.73	625.31	604.82	844.65	644.73	587.26	720.17	676.97	956.64	662.25	461.46	677.73	130.53
Meat and Eggs	418.79	273.76	613.71	537.55	450.75	534.22	729.73	813.15	564.43	364.20	516.26	526.96	154.68
Dairy	620.09	524.51	589.60	565.79	360.45	810.20	1479.48	614.15	869.77	713.74	721.15	744.45	280.90
Other	768.32	524.94	527.21	842.70	821.15	663.63	1121.13	820.21	1010.65	636.37	490.01	766.47	184.63
Vegetables and Fruit	640.74	485.90	527.16	460.96	1263.46	623.90	493.16	374.31	501.00	471.41	556.60	584.80	243.54
Other Food	1734.96	1741.62	182.15	1362.70	2155.06	1744.50	1423.66	1475.06	1806.21	1808.82	1604.93	1674.33	231.01
Food Amp.	973.42	904.13	1055.87	890.16	1069.18	1469.32	1063.69	1039.21	1445.15	855.92	903.92	1065.47	198.37

Source: IBGE, 1982

Table 3.13 Average Budget Shares for Seven Food Groups, by Region, Including Zeros
Groups

	NO DE JANEIRO	PARTO ALONSO	SELO HORIZONTE	RECIFE	SÃO PAULO	DETROIT FERNAL	BELEM	FORTALEZA	SALVADOR	CURITIBA	SOMMA	NAT AVERAGE	STD DEV
Wheat, Feed and Seed	0.11	0.12	0.10	0.15	0.09	0.09	0.10	0.12	0.14	0.12	0.09	0.11	0.02
Meat, and Beans	0.07	0.05	0.10	0.10	0.07	0.08	0.10	0.14	0.14	0.07	0.10	0.09	0.02
Beef	0.11	0.15	0.10	0.10	0.06	0.13	0.21	0.11	0.13	0.12	0.14	0.12	0.02
Other Meat	0.13	0.11	0.11	0.15	0.12	0.10	0.16	0.14	0.15	0.12	0.09	0.15	0.02
Vegetables and Fruit	0.11	0.09	0.09	0.09	0.19	0.10	0.07	0.06	0.07	0.09	0.11	0.10	0.03
Other Food	0.30	0.32	0.31	0.24	0.32	0.27	0.20	0.25	0.23	0.33	0.31	0.28	0.04
Food Group	0.17	0.17	0.18	0.16	0.16	0.22	0.15	0.18	0.21	0.16	0.17	0.17	0.02

Source: IBGE, 1992.

Table 3.14 Average Prices Paid for Food Groups, by Region, in Czs

	RIO DE JANEIRO	PORTO ALEGRE	BELO HORIZONTE	RECIFE	SÃO PAULO	DISTRITO FEDERAL	BELEM	PORTALEZA	SALVADOR	CURITIBA	GOIANA	NAT AVERAGE	STD DEV
Wheat, Pasta and Bread	18.13	25.15	18.78	24.48	19.11	18.11	20.15	17.05	21.52	25.80	18.17	20.59	3.17
Meat and Beans	55.39	37.30	90.52	35.37	83.63	96.12	32.18	41.28	39.88	59.68	79.56	59.17	24.17
Beef	144.64	105.46	128.73	134.87	132.66	152.76	142.52	147.79	157.04	117.04	121.77	136.03	15.90
Other Meat	70.32	66.61	73.62	71.05	84.73	82.62	99.14	59.75	78.75	63.57	75.10	75.02	11.06
Vegetables and Fruit	13.09	9.10	10.29	11.40	31.46	21.01	11.96	13.58	16.23	20.40	13.03	15.60	6.50
Other Food	36.70	39.21	38.83	41.34	40.95	39.37	42.98	30.71	39.82	38.27	35.48	38.52	3.33
Food Away	65.72	90.72	68.22	61.40	11.72	100.25	69.46	52.31	69.27	90.15	63.14	67.30	23.53

Source: IBGE, 1992

that zero observations are treated as a non-purchases.

The inclusion of zero observations in the model poses two problems. First, estimated budget shares can be negative or exceed one under the assumption of multivariate normal error terms. However, Woodland (1979) compared demand systems estimates made with a multivariate normal error term with an alternative specification using non-normal error structure. He found the differences to be small. Given the aggregation scheme adopted, for most groups, the percentage of reported consumption was over 80% (Table 3.15). That is expected to minimize the problem.

The second problem is that price information for goods with no-reported expenditure is not available. To estimate the model, information on all prices is required (Heien and Wessels, 1988). There are few alternatives to deal with the problem. In this research two alternatives were contemplated: i) delete zero consumption observations. Although this alternative is attractive given that it would also contribute to decrease the number of observations. However, it was shown by Heckman (1979) to yield biased estimates; i) to include zero observations and assign a price that would most likely be related to the non-consumption. The strategy adopted was to fit regional regressions of observed prices on household size, a seasonal

Table 3.15 Percentage of Households with Reported Purchases of Food, by Region

FOODS	RIO DE JANEIRO	PORTO ALEGRE	BELO HORIZONTE	RECIFE	SÃO PAULO	DISTRITO FEDERAL	BELEM	FORTALEZA	SALVADOR	CURITIBA	GOIANA	MAT. AVERAGE	STD DEV
Wheat, Pasta and Bread	96.3%	98.1%	95.8%	96.2%	97.0%	93.7%	96.9%	95.9%	97.8%	95.9%	93.2%	96.1%	1.5%
Meat and Beans	76.1%	76.5%	75.8%	88.5%	67.5%	70.8%	94.3%	90.6%	87.4%	73.8%	76.2%	79.8%	8.8%
Beef	61.3%	85.8%	59.9%	71.2%	52.5%	73.9%	91.5%	69.1%	79.3%	45.5%	55.4%	67.8%	14.4%
Other Meat	73.3%	91.4%	71.6%	92.2%	57.9%	84.4%	94.9%	92.9%	91.7%	77.0%	79.0%	82.4%	11.7%
Vegetables and Fruit	81.3%	95.0%	81.4%	91.6%	80.6%	87.9%	93.7%	91.6%	92.0%	79.4%	75.9%	85.4%	6.8%
Other Food	69.1%	59.4%	61.1%	97.0%	95.8%	87.0%	98.0%	98.0%	87.7%	64.8%	45.7%	84.0%	19.7%
Food Away	75.7%	71.0%	73.6%	76.3%	86.8%	78.7%	78.9%	82.8%	82.7%	74.3%	72.4%	77.6%	4.9%

Source: IBGE, 1992

variable (month of expenditure) and on a variable that would be correlated with the search (frequency of purchases). The statistical properties of this procedure are discussed by Gouriéroux and Monfort (1981) and Dagenais (1983).

CHAPTER 4

ESTIMATION AND ANALYSIS OF THE RESULTS

In this chapter, the Florida-Slutsky model (Theil, Chung and Seale, 1989), derived in Section 2.8, is presented in matrix notation in Section 4.1. Maximum likelihood (ML) procedures used to estimate the model parameters are presented in Section 4.2. The analysis of the results from estimation starts in Section 4.3. Income elasticities are discussed in Sections 4.4 and 4.5, and price elasticities are discussed in 4.6.

4.1 The Florida-Slutsky Model in Matrix Notation

The conditional demand equation for good i , belonging to group g , for household h , for the Florida-Slutsky model derived in 2.79 is defined as (subscripts h added for clarity)

$$(4.1a) \quad \frac{w_{ih}}{w_h^F} = (\alpha_i + \beta_i q_h^F) +$$

$$(4.1b) \quad (\alpha_i + \beta_i q_h^F) \left[\log \frac{p_{ih}}{p^{F*}_i} - \sum_{\substack{j=1 \\ j \in S_g}}^n (\alpha_j + \beta_j q_h^F) \log \left[\frac{p_{jh}}{p^{F*}_j} \right] + \right.$$

$$(4.1c) \quad \sum_{j=1}^n \pi_{ij} \log \left[\frac{p_{jh}}{p^*_{.j}} \right] + \epsilon_{ih},$$

$j \in S_g$

where w_{ih} and w^F_h are the budget share of good i and total food expenditure for household h , respectively, q^F_h is the per-capita expenditure on food for household h ,

$$(4.2) \quad q^F_h = \frac{\sum_{i=1}^N p_i q_i}{S},$$

$i \in S_F$

given by the sum of expenditures on all goods belonging to the food group, S_F , divided by the number of individuals in the household, S , and p^{F*}_i is the geometric mean price of good i , given by

$$(4.3) \quad \log p^*_{.i} = \frac{1}{H} \sum_{h=1}^H \log p_{ih}.$$

The stochastic error term ϵ_{ih} is the i th element of an stochastic error vector that is assumed to have an independent normal distribution with zero mean and singular covariance matrix Σ . The restrictions on parameters α s and β s (2.50) are used to eliminate α_N and β_N . Since $\epsilon_{1h} + \epsilon_{2h} + \dots + \epsilon_{nh} = 0$ holds with probability one, a equation can be disregarded

(Theil et al., pp. 44). Maximum likelihood estimation of (4.1) yields parameter estimates that are invariant to which equation is deleted (Barten 1969), so that the n th equation was chosen to be deleted. Equation (4.1) in matrix notation is written as $w_h = f_h(\theta) + \varepsilon_h$, where θ is a vector consisting of three sub-vectors: α , β , and $\text{Vec}^1 \pi$, and $f_h(\theta)$ is defined as

$$(4.4) \quad f_h(\theta) = \alpha + q_h \beta + X_h (\alpha + q_h \beta) - \\ (\alpha + q_h \beta) X_h' (\alpha + q_h \beta) + \pi_{ih} Z,$$

where X_h is a $n-1$ diagonal square matrix, with diagonal elements given by x_{ih} , and x_h is a $n-1 \times 1$ column vector with elements x_{ih} given by

$$(4.5) \quad x_{ih} = \ln\left(\frac{p_{ih}}{p_{*i}}\right) - \ln\left(\frac{p_{nh}}{p_{*n}}\right).$$

Because not all households reported expenditures on all food groups, purchase prices were not reported. Whenever a price was not available for a food group, an implicit price, x_{ih}^* ,

¹ operator that transforms a $n \times n$ matrix into a $n^2 \times 1$ vector.

calculated according to the method discussed in Section 3.8, was used².

The parameters α s and β s were further restricted to satisfy the homogeneity and symmetry restrictions implied by the theory, that were discussed Section 2.2. The homogeneity restriction (2.39) was imposed by normalizing the food group prices, that is by expressing prices of the food groups relatively to the price of group n. The symmetry of the Slutsky price matrix, π_{ij} was imposed by constructing the matrix of normalized prices, Z as in Table 4.1.

4.2 Maximum Likelihood Procedures

The log-likelihood function corresponding to (4.1) is given by (Theil et al., 1989, pp.46-47)

$$(4.6) \quad L = C + 0.5 H \ln |\Sigma^{-1}| - 0.5 \sum_{h=1}^H [w_h - f_h(\theta)]' \Sigma^{-1} [w_h - f_h(\theta)].$$

The log-likelihood function should be maximized with respect to parameters θ and Σ . Maximizing (4.6) with respect to Σ given θ yields the concentrated log-likelihood function

² Alternatively, the model was also estimated with deleted observations regarding non-reported food consumption, with results reported in Appendix C.

Table 4.1 Price Matrix Z (%)[illegible]

(11) Prices for Groups are Normalized by the Price of the 7th. Group

$$(4.7) \quad L_c = C + 0.5 H \ln |R(\theta)^{-1}|,$$

where

$$(4.8) \quad R(\theta) = - \frac{1}{N} \sum_{h=1}^H [w_h - f_h(\theta)] [w_h - f_h(\theta)]'.$$

The concentrated log-likelihood function has a derivative with respect to θ of the form

$$(4.9) \quad \frac{dL_c}{d\theta'} = \sum_{h=1}^H \frac{d f_h(\theta)}{d\theta'} R(\theta)^{-1} [w_h - f_h(\theta)],$$

where

$$(4.10) \quad \frac{d f_h(\theta)}{d\theta'}$$

consists of three submatrices:

$$(4.11) \quad \frac{d f_h(\theta)}{d\alpha'} = A,$$

$$(4.12) \quad \frac{d f_h(\theta)}{d\beta'} = q, A, \text{ and}$$

$$(4.13) \quad \frac{d f_h(\theta)}{d \pi'} = Z_h, \text{ where}$$

$$(4.14) \quad A = X_h - (\alpha + q_h \beta) x_h' + [1 - (\alpha + q_h \beta)' x_h] I_{n-1}$$

The asymptotic covariance matrix of the ML estimator of θ is equal to minus the inverse of the expectation of the second derivative of the concentrated log-likelihood function $d^2 L_c / d\theta d\theta'$ with respect to the parameter vector θ ³.

$$(4.15) \quad K(\theta) = - \sum_{h=1}^H \frac{d f_h(\theta)' }{d \theta'} R(\theta)^{-1} \frac{d f_h(\theta)}{d \theta'}.$$

The maximum likelihood estimates of the parameter vector θ^* were obtained by application of the method of scoring (Cramer, 1986; Harvey, 1990). Asymptotic standard errors of the parameters θ s are given by the square root of the main diagonal of the asymptotic covariance matrix $-K(\theta)^{-1}$.

³ The second derivative of the concentrated log-likelihood function with respect to the parameter vector θ is of the form

$$(FN 4.1) \quad \frac{d^2 L_c}{d\theta d\theta'} = K(\theta) + J(\theta).$$

The matrix $J(\theta)$ is linear in $[w_h - f_h(\theta)]$ for $h=1, \dots, H$. Thus, $J(\theta)$ has zero expectation (Theil et al., 1989, pp. 47).

4.3 Analysis of the Results

Maximum likelihood estimates of the parameters α s and β s, and their respective asymptotic standard errors are reported in Table 4.2. Parameters that are not statistically significantly different from zero are marked with a star sign on the left side. Considering parameter estimates for the 11 regions, 58 out of 77 β s are significantly different from zero. All β s are statistically significant for the groups: Wheat, Pasta and Bread, Manioc and Beans, and Vegetables and Fruit, while almost half of the parameters, or 16 out of 66 estimated β s are not significantly different from zero, (indicating unitarian income elasticity) for the groups: Beef, Other Meat and Other Food.

Maximum likelihood estimates of the price coefficients π_{ij} s are reported in Table 4.3. All diagonal elements, π_{ii} s, but two are significantly different from zero. The number of off-diagonal elements that are not significantly different from zero are much higher, 123 out of 426. The diagonal elements of the π_{ij} matrix should be negative, for the negativity restriction (2.11) to hold. Out of 77 diagonal elements, π_{ii} s for the 11 regions of the country, 69 have the right sign, against 8 that have the wrong signs. Regarding

Table 4.2 Florida-Slutsky Model, Parameter Estimates for 11 Regions of Brazil. Standard Errors in Parenthesis
(*) Parameters not Statistically Different from Zero

Food Group	RIO DE JANEIRO	PORTO ALEGRE	RIO DE HORIZONTE	RECIFE	SAO PAULO	α Region					SALVADOR	CURITIBA	GOIANA
						DISTITO FEDERAL	BELEM	FORTALEZA	SALVADOR	CURITIBA			
Wheat, Pasta and Bread	0.168 (0.006)	0.157 (0.008)	0.149 (0.007)	0.230 (0.008)	0.156 (0.008)	0.125 (0.007)	0.156 (0.007)	0.175 (0.006)	0.225 (0.006)	0.144 (0.007)	0.129 (0.006)		
Manioc and Beans	0.160 (0.007)	0.129 (0.007)	0.176 (0.012)	0.190 (0.007)	0.182 (0.012)	0.201 (0.012)	0.210 (0.012)	0.235 (0.009)	0.161 (0.006)	0.150 (0.008)	0.188 (0.010)		
Beef	0.120 (0.013)	0.237 (0.013)	0.128 (0.012)	0.115 (0.011)	0.157 (0.018)	0.203 (0.016)	0.271 (0.025)	0.100 (0.012)	0.162 (0.010)	0.176 (0.013)	0.156 (0.012)		
Other Meat	0.151 (0.011)	0.128 (0.011)	0.160 (0.011)	0.228 (0.011)	0.101 (0.016)	0.129 (0.012)	0.184 (0.019)	0.214 (0.010)	0.178 (0.010)	0.138 (0.010)	0.116 (0.010)		
Vegetables and Fruit	0.044 (0.011)	0.054 (0.007)	0.056 (0.009)	0.067 (0.007)	0.100 (0.024)	0.071 (0.010)	0.078 (0.023)	0.032 (0.006)	0.038 (0.006)	0.059 (0.008)	0.058 (0.010)		
Other Food	0.217 (0.013)	0.318 (0.014)	0.206 (0.015)	0.139 (0.011)	0.246 (0.023)	0.233 (0.017)	0.105 (0.016)	0.170 (0.011)	0.163 (0.010)	0.259 (0.014)	0.274 (0.012)		

Food Group	RIO DE JANEIRO	PORTO ALEGRE	RIO DE HORIZONTE	RECIFE	SAO PAULO	β Region					SALVADOR	CURITIBA	GOIANA
						DISTITO FEDERAL	BELEM	FORTALEZA	SALVADOR	CURITIBA			
Wheat, Pasta and Bread	-0.024 (0.002)	-0.014 (0.003)	-0.019 (0.003)	-0.035 (0.003)	-0.025 (0.003)	-0.013 (0.003)	-0.026 (0.003)	-0.025 (0.002)	-0.040 (0.002)	-0.012 (0.003)	-0.017 (0.002)		
Manioc and Beans	-0.027 (0.003)	-0.022 (0.002)	-0.024 (0.004)	-0.036 (0.003)	-0.025 (0.004)	-0.036 (0.004)	-0.033 (0.004)	-0.042 (0.003)	-0.026 (0.002)	-0.025 (0.003)	-0.029 (0.004)		
Beef	* -0.009 (0.004)	-0.025 (0.005)	* -0.002 (0.004)	-0.013 (0.005)	-0.023 (0.006)	-0.014 (0.006)	-0.045 (0.009)	0.021 (0.005)	* -0.002 (0.004)	* -0.009 (0.005)	* 0.004 (0.005)		
Other Meat	* -0.003 (0.004)	* -0.004 (0.004)	-0.017 (0.004)	-0.030 (0.004)	* 0.005 (0.006)	* -0.005 (0.004)	* -0.012 (0.007)	-0.030 (0.016)	-0.008 (0.004)	-0.010 (0.004)	* -0.001 (0.004)		
Vegetables and Fruit	0.027 (0.004)	0.009 (0.003)	0.017 (0.003)	0.011 (0.003)	0.028 (0.008)	0.011 (0.004)	0.029 (0.004)	0.016 (0.002)	0.015 (0.002)	0.010 (0.003)	0.021 (0.004)		
Other Food	* -0.003 (0.004)	-0.028 (0.005)	0.013 (0.005)	0.022 (0.004)	* 0.000 (0.008)	* -0.002 (0.006)	0.015 (0.006)	0.013 (0.004)	* 0.005 (0.004)	* -0.005 (0.005)	-0.020 (0.005)		

the 8 coefficients with the wrong sign 6 are in the Food Away from Home group. The relative small number of parameter estimates, π_{ij} s with wrong signs is not surprising considering: 1) the large total number of parameters in the model, and 2) the fact that most price parameters with wrong signs are concentrated in the Food Away from Home group that is known to be less homogeneous than the other groups. Thus, it is likely that prices of this group are much more subject to errors in measurement.

The signs of the off-diagonal elements of the π_{ij} s matrices determine whether goods are substitutes or complements. The substitution effect implies that as the price of a good goes up, consumption of a substitute good increases. A good is said to be a complement to another if an increase in its price results in a decrease in consumption of a complementary good. Given that the π_{ij} matrix is symmetric (Appendix A, Equation A.22), if good A is a substitute (complement) to good B, so good B is a substitute (complement) to good A. Based on parameter estimates, π_{ij} s (Table 4.3), it can be concluded that Manioc and Beans are substitutes for Wheat, Pasta and Bread, Other Meat is a substitute for Beef, and Fruit and Vegetables are complements to Wheat, Pasta and Bread.

4.4 Conditional and Unconditional Income Elasticities

The income elasticity for good i , η_i , is given by (Appendix A, equation A.30)

$$(4.16) \quad \eta_i = 1 + \frac{\beta_i}{w_i}.$$

Given that the budget share of good i , w_i lies between zero and one, the sign of β_i determines whether the income elasticity, η_i is smaller or larger than one, thus determining whether a good is a luxury or a necessity. For $\beta_i > 0$, good i is a luxury good, its budget share increases with income. For $\beta_i < 0$, good i is a necessity, its budget share decreases with income.

Income elasticities (4.16) can be of two types: *unconditional* income elasticities, that stand for a measure of proportional changes on the quantity consumed of a good, caused by changes in total expenditure, and *conditional* income elasticities, that stand for a measure of proportional changes on the quantity consumed of a good caused by changes in the expenditure on food. The two types of income elasticities are presented and discussed below.

The conditional income elasticity of demand for good i , η_i^C is given by

$$(4.17) \quad \eta_i^C = 1 + \frac{\beta_i}{w_i^C},$$

where β_i is taken from parameter estimates of the conditional demand equations (4.17), and w_i^C is the conditional budget share of good i , that is given by the budget share of the good i , w_i , divided by the budget share of food, w_i^F . (Table 4.4).

Conditional income elasticities have the interpretation that as expenditure on food increases, expenditure on the group increases proportionally more for elasticities larger than one, or less for elasticities smaller than one. For all regions, conditional income elasticities calculated at the average budget share are smaller than one for the Wheat and Beans groups; larger than one for the Fruit and Food Away from Home groups. For the Beef, Other Meat and Other Food groups, conditional income elasticities are either larger or smaller than one, depending on the region considered.

The unconditional income elasticity of demand for good i , η_i^U can be calculated by multiplying the conditional income elasticity of good i , by the income elasticity of demand of food as a group. It is given by

Table 4.4 Conditional Income Elasticities for Food Groups for 11 Regions of Brazil

	RIO DE JANEIRO	PORTO ALEGRE	SILV. NOROCCENTE	RECIFE	SÃO PAULO	DISTRITO FEDERAL	BRASÍLIA	FORTALIZA	SALVADOR	CUIABÁ	GOIÂNIA
Wheat, Pasta and Bread	0.79	0.88	0.82	0.78	0.73	0.86	0.75	0.79	0.71	0.90	0.81
Meat and Beans	0.63	0.57	0.77	0.63	0.62	0.57	0.68	0.70	0.68	0.62	0.70
Bird	* 1.08	0.84	* 1.02	1.12	0.59	0.89	0.79	1.20	* 0.98	* 0.93	* 1.03
Other Meat	* 0.98	* 0.96	0.85	0.81	* 1.04	* 0.95	* 0.93	0.78	0.94	0.91	* 0.99
Vegetables and Fruit	1.24	1.10	1.18	1.13	1.15	1.11	1.41	1.25	1.21	1.12	1.20
Other Food	1.01	0.91	1.04	1.09	* 1.00	* 0.99	1.07	1.05	* 1.02	* 0.99	0.93
Food Energy	1.09	1.50	1.16	1.34	1.26	1.27	1.47	1.26	1.27	1.33	1.25

(*) Parameters not statistically different from unitary.

$$(4.18) \quad \eta_i^U = \eta_F \eta_i^C,$$

where η_i^C is the conditional income elasticity of demand for good i (4.17), and η_F is the income elasticity for total food expenditure, given by

$$(4.19) \quad \eta_F = 1 + \frac{\beta_F}{w_F},$$

where w_F is the budget share of food, that is given by expenditures on food over total expenditure, and β_F is the parameter estimate in the group demand equations (2.81).

The parameter β_F can be estimated in two different ways. The parameter β_F can be estimated from (2.81), using expenditure and prices data for the food and non-food groups. This alternative was not technically feasible, so that β_F was instead estimated according to (2.49). This was done by regressing the budget share of food on a constant and on the logarithm of total expenditure, using data pooled from all regions. The parameter estimates are: $\alpha_F = 1.2184$, and $\beta_F = -0.1046$.

The income elasticity of demand for food in Brazil was calculated from those parameter estimates as follows: at the average income level, Q of CZ\$ 6,000.00, the predicted budget

share for food, given by $w_F^P = \alpha_F + \beta_F \log Q$ is 0.31. At this budget share, the income elasticity for the food in Brazil is 0.66. This value is comparable to 0.61, the income elasticity of demand for food in Brazil calculated from parameter of a Florida-PI model, estimated using cross-country data (Theil et al., 1989).

Unconditional income elasticities for the seven food groups (4.20) were calculated for the 11 regions of Brazil (Table 4.5). For all regions, unconditional income elasticities calculated at the average budget share, and using the value of $\eta_F = 0.66$, are smaller than one for all food groups. The interpretation of this income elasticity of demand for food is that as the average total expenditure (income) in Brazil grows, expenditure on the food groups grows less than proportionally. The elasticities are quite different across groups and regions, so that changes in the average income affect expenditure on the groups differently. For example, income elasticities for Food Away from Home is almost twice the elasticities for the Wheat and the Beans groups. It is worthwhile to note that the elasticities were calculated at predicted average budget shares corresponding to the average expenditures on the food groups. Given that the budget shares vary with the level of income (2.49), unconditional income elasticities (4.20) also vary with the

Table 4.5 Unconditional Income Elasticities for Food Groups for 11 Regions of Brazil

	RIO DE JANEIRO	PORTO ALÉGRE	SÃO CARLOS	SÃO PAULO	GUARATINGUETÁ	BELO HORIZONTE	RECIFE	RECIFE	PORTALEZA	SALVADOR	CURITIBA	BOAMA
Wheat, Pasta and Bread	0.52	0.58	0.54	0.51	0.48	0.57	0.49	0.52	0.47	0.59	0.59	0.53
Meat, Poultry and Beans	0.41	0.38	0.51	0.42	0.41	0.38	0.45	0.46	0.45	0.41	0.41	0.46
Beef	0.71	0.55	0.67	0.74	0.39	0.59	0.52	0.79	0.65	0.61	0.61	0.68
Other Meat	0.65	0.63	0.56	0.53	0.69	0.53	0.61	0.52	0.62	0.60	0.60	0.65
Vegetables and Fruit	0.82	0.73	0.78	0.74	0.76	0.73	0.93	0.83	0.80	0.74	0.74	0.79
Other Food	0.67	0.60	0.69	0.72	0.66	0.65	0.71	0.69	0.67	0.65	0.65	0.62
Food Away	0.72	0.59	0.76	0.89	0.83	0.84	0.97	0.83	0.84	0.88	0.88	0.82

level of income. The extent that income elasticities vary according to the income level is discussed in the next section.

4.5 Income Elasticities at Various Levels of Income

Income elasticities are usually reported at the average budget share. However, given that the budget shares of the food groups vary with the level of expenditure - most estimated β_1 s in equation 2.49 (Table 4.2) are statistically different from zero - the income elasticities of demand for the food groups also vary with the level of expenditure (income). It is thus worthwhile to report income elasticities associated to the levels of expenditure on food (conditional) and on total expenditure (unconditional). In order to calculate the conditional income elasticities of demand at various levels of expenditure on food (4.17), predicted values for the budget shares associated to various levels of food expenditure according were calculated using (2.79). Those predicted budget shares were then used to calculate conditional income elasticities of demand at various levels of income. Instead of reporting income elasticities for each regions separately, summary measures of the conditional income

elasticities of demand for good i in Brazil (Table 4.6) were calculated according to

$$(4.20) \quad \eta^{c'}_{i} = 1 + \frac{\beta'_{i}}{w'_{i}},$$

where β'_{ir} and w'_{ir} are parameter averages for the 11 regions, $r = 1, 2, \dots, R$, given by, respectively,

$$(4.21) \quad \beta'_{i} = \frac{1}{R} \sum_{r=1}^R \beta_{ir}, \text{ and}$$

$$(4.22) \quad w'_{i} = \frac{1}{R} \sum_{r=1}^R w^c_{ir}.$$

Conditional on food expenditures, the income elasticities of demand for Wheat, Pasta and Bread, Manioc and Beans, Beef, and Other Meat are smaller than one. For the other groups: Vegetables and Fruit, Other Food and Food Away from Home, conditional income elasticities of demand are larger than one. Income elasticities for all food groups decrease with the level of expenditure on food, indicating that at higher levels of expenditure on food, changes in food expenditures have a lesser impact on the quantities consumed of food groups.

Table 4.6 Florida-Slutsky Model, Conditional Income Elasticities, at Various Levels of Total Expenditure

Per Capita Expenditure (Cz\$)	3000	4500	6000	7500	9000	10500	12000
Wheat, Pasta and Bread	0.79	0.78	0.77	0.76	0.76	0.75	0.75
Meat and Beans	0.72	0.69	0.67	0.66	0.65	0.63	0.62
Beef	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Other Meat	0.92	0.92	0.92	0.92	0.92	0.91	0.91
Vegetables and Fruit	1.17	1.16	1.16	1.15	1.15	1.15	1.15
Other Food	1.01	1.01	1.01	1.01	1.01	1.01	1.01
Food Away	1.28	1.26	1.24	1.24	1.23	1.22	1.22

Conditional on food expenditures, the income elasticities indicate that as expenditure on food increases, households will spend proportionally more on Vegetables and Fruit, Other Food (that includes beverages), and Food Away from Home. Also, conditional on expenditure on food, consumers would spend proportionally less on Wheat, Pasta and Bread, Rice, Beans and Manioc, and Other Meat. For the groups Beef and Other Food, given the large number of parameters β_i not statistically significantly different from zero, consumption would grow with income.

Unconditional income elasticities at various income levels for Brazil were calculated according to (4.20), by multiplying the conditional income elasticities, η^c_i in (4.20) by the income income elasticity for food, η_F in (4.21). Predicted budget shares for total food expenditure and for the seven food groups, corresponding to various income levels of expenditure were calculated by $w^F_F = \alpha_F + \beta_F \log Q$, and $w^P_i = \alpha_i + \beta_i \log q^F$, respectively. All food groups considered exhibit unconditional income elasticities smaller than one at all levels of expenditure (Table 4.7), suggesting that as total expenditure (income) increases, expenditure on the food groups increase less than expenditure on non-food goods. That is because of the change in expenditures on food

Table 4.7 Florida-Slutsky Model, Unconditional Income Elasticities, at Various Levels of Total Expenditure

Per Capita Expenditure (cz\$)	3000	4500	6000	7500	9000	10500	12000
Wheat, Pasta and Bread	0.58	0.54	0.51	0.48	0.46	0.44	0.41
Manioc and Beans	0.52	0.48	0.45	0.42	0.39	0.37	0.35
Beef	0.70	0.66	0.63	0.61	0.58	0.56	0.53
Other Meat	0.67	0.63	0.61	0.58	0.55	0.53	0.51
Vegetables and Fruit	0.85	0.80	0.77	0.73	0.70	0.67	0.64
Other Food	0.73	0.70	0.66	0.64	0.61	0.58	0.56
Food Away	0.92	0.87	0.82	0.78	0.75	0.71	0.68

and non-food groups have to add up to the change in total expenditure (adding up restriction, 2.4). Also, expenditures on all food groups increase proportionally less with income, indicating that all food groups are necessities, although no inferior good (negative income elasticity) was found, at least for the range of income considered.

These findings are in line with Strauss et al. (1992), except for the fact that they found negative income elasticities (inferior goods) for a few goods at higher levels of total expenditure. For a good to be inferior, its budget share has to be smaller than the absolute value of the parameter β_1 . Disregarding differences on how food goods were aggregated in both studies, and considering that the budget share of all seven food groups are relatively large, what was expected in the case of a low-middle income country like Brazil, the findings of this study regarding the value of income elasticities seem more plausible.

The income elasticities for Fruit and Vegetable at various income levels are higher than the income elasticity of demand for staples like Wheat, Pasta and Bread and Manioc and Beans, leading to the conclusion that staples are less elastic than other food groups at all levels of income. Also, it was found that income elasticities for all food

groups decrease with income. This latter finding supports the conclusion that income growth at lower income levels, say for poorer households, has a larger impact on food consumption. The variation in income elasticities according to income levels have important implications for the study of the impact of changes in income distribution on consumption of food goods.

4.6 Price Elasticities

The compensated or Slutsky price elasticity measures proportional changes in quantities due to changes in the price of a good, holding real income constant. It is given by (Appendix A, equation A.33)

$$(4.22) \quad \epsilon_{ij}^c = \frac{\pi_{ij}}{w_i},$$

where π_{ij} is the Slutsky price coefficient, and w_i is the budget share. Compensated price elasticities for the 11 regions in Brazil are presented in Table 4.8. Own price elasticities calculated at the average budget shares for each region vary in the range of -0.02 to -0.60 (excluding parameters with wrong signs). The mean value for the range is close to the own-price elasticity for food in Brazil

Table 4.8 Florida-Slutsky Model, Price Elasticities for 11 Regions
 (*) Parameters not Statistically Different from Zero

FLORIDA-SLUTSKY MODEL							
SLUTSKY PRICE ELASTICITIES							
REGION NUMBER 01: RIO DE JANEIRO							
Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away	
Wheat, Pasta and Rice	-0.21	0.12	0.02	-0.03	-0.06	0.09	-0.14
Manioc and Beans	0.19	-0.49	0.13	-0.03	0.02	0.12	0.05
Beef	0.02	0.09	-0.45	0.07	-0.04	0.24	0.07
Other Meat	-0.02	-0.01	0.06	-0.20	0.12	-0.06	0.13
Vegetables and Fruit	-0.06	0.01	-0.04	0.14	-0.22	0.13	0.04
Other Food	0.04	0.03	0.09	-0.03	0.05	-0.21	0.04
Food Away	-0.10	0.02	0.05	0.10	0.03	0.08	-0.17

FLORIDA-SLUTSKY MODEL							
SLUTSKY PRICE ELASTICITIES							
REGION NUMBER 02: PORTO ALEGRE							
Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away	
Wheat, Pasta and Rice	-0.27	0.06	0.05	0.11	-0.01	-0.01	-0.23
Manioc and Beans	0.19	-0.25	0.03	0.05	-0.10	0.03	0.06
Beef	0.04	0.01	-0.28	0.00	0.04	0.18	0.03
Other Meat	0.12	0.02	-0.01	-0.19	-0.02	0.21	-0.13
Vegetables and Fruit	-0.01	-0.06	0.06	-0.03	-0.15	0.14	0.04
Other Food	0.00	0.00	0.08	0.07	0.04	-0.22	0.02
Food Away	-0.16	0.02	0.03	-0.08	0.02	0.05	0.13

FLORIDA-SLUTSKY MODEL							
SLUTSKY PRICE ELASTICITIES							
REGION NUMBER 03: BELO HORIZONTE							
Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away	
Wheat, Pasta and Rice	-0.22	0.03	0.01	0.12	0.07	0.03	-0.27
Manioc and Beans	0.03	-0.33	-0.05	0.12	0.01	0.29	-0.07
Beef	0.01	-0.05	-0.24	0.13	0.12	0.09	-0.06
Other Meat	0.11	0.11	0.11	-0.70	0.12	0.22	0.03
Vegetables and Fruit	0.06	0.01	0.13	0.14	-0.60	0.22	0.01
Other Food	0.01	0.10	0.03	0.06	0.06	-0.23	-0.05
Food Away	-0.15	-0.04	-0.03	0.02	0.01	-0.09	0.29

FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 04: RECIFE

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bre.	-0.31	0.10	0.02	0.09	-0.08	0.11	-0.24
Manioc and Beans	0.16	-0.45	0.06	0.09	0.04	0.07	0.03
Beef	0.03	0.05	-0.49	0.13	0.07	0.13	0.07
Other Meat	0.09	0.06	0.09	-0.34	0.09	0.08	-0.07
Vegetables and Fruit	-0.14	0.05	0.08	0.16	-0.35	0.12	0.08
Other Food	0.07	0.03	0.06	0.05	0.04	-0.29	0.04
Food Away	-0.23	0.02	0.05	-0.06	0.04	0.06	0.12

FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 05: SAO PAULO

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bre.	-0.20	0.02	-0.02	0.05	0.02	0.06	-0.13
Manioc and Beans	0.02	-0.11	0.05	-0.04	-0.10	0.15	0.03
Beef	-0.03	0.06	0.02	0.10	-0.07	-0.12	0.03
Other Meat	0.04	-0.02	0.05	-0.15	0.07	0.07	-0.05
Vegetables and Fruit	0.01	-0.04	-0.02	0.04	-0.23	0.27	-0.03
Other Food	0.02	0.03	-0.02	0.03	0.16	-0.24	0.02
Food Away	-0.08	0.01	0.01	-0.04	-0.04	0.04	0.08

FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 06: DISTRITO FEDERAL

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bre.	-0.16	0.08	0.04	-0.01	-0.04	0.03	-0.11
Manioc and Beans	0.09	-0.18	0.01	-0.12	-0.03	0.22	0.01
Beef	0.03	0.01	-0.31	0.01	0.07	0.10	0.09
Other Meat	0.00	-0.10	0.02	-0.07	0.11	-0.05	0.09
Vegetables and Fruit	-0.04	-0.03	0.09	0.12	-0.38	0.19	0.05
Other Food	0.01	0.07	0.05	-0.02	0.07	-0.24	0.06
Food Away	-0.05	0.00	0.02	0.04	0.02	0.07	-0.14

FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 07: BELEM

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bre	-0.31	0.09	0.05	0.03	-0.05	0.13	-0.25
Manioc and Beans	0.09	-0.49	0.21	0.09	0.13	-0.06	0.03
Beef	0.02	0.10	-0.35	0.08	0.01	0.10	0.03
Other Meat	0.02	0.06	0.11	-0.31	0.08	0.02	0.02
Vegetables and Fruit	-0.07	0.19	0.02	0.18	-0.59	0.25	0.02
Other Food	0.06	-0.03	0.10	0.02	0.09	-0.31	0.07
Food Away	-0.17	0.02	0.05	0.03	0.01	0.09	-0.02

FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 08: FORTALEZA

	Wheat, Pasta and Bread	Manioc And Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bre	-0.37	0.14	0.04	0.05	0.00	0.10	-0.33
Manioc and Beans	0.12	-0.47	0.10	0.08	0.05	0.05	0.08
Beef	0.04	0.13	-0.61	0.15	0.06	0.16	0.07
Other Meat	0.04	0.08	0.11	-0.35	0.04	0.15	-0.07
Vegetables and Fruit	0.00	0.10	0.09	0.10	-0.55	0.26	0.00
Other Food	0.05	0.03	0.07	0.09	0.07	-0.31	0.02
Food Away	-0.21	0.07	0.04	-0.06	0.00	0.02	0.14

FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 09: SALVADOR

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bre	-0.20	0.12	0.04	-0.04	-0.07	0.11	-0.15
Manioc and Beans	0.18	-0.37	0.08	-0.02	0.00	0.11	0.01
Beef	0.05	0.05	-0.40	0.07	-0.07	0.23	0.07
Other Meat	-0.04	-0.01	0.05	-0.15	0.10	-0.02	0.06
Vegetables and Fruit	-0.07	0.00	-0.07	0.13	-0.12	0.11	0.02
Other Food	0.04	0.03	0.08	-0.01	0.04	-0.22	0.03
Food Away	-0.10	0.00	0.05	0.05	0.01	0.05	-0.06

FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 10: CURITIBA

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bze.	-0.25	0.05	-0.03	0.04	-0.06	0.17	-0.17
Manioc and Beans	0.09	-0.31	-0.01	0.06	-0.03	0.22	-0.03
Beef	-0.02	0.00	-0.22	-0.03	0.03	0.13	0.11
Other Meat	0.05	0.04	-0.03	-0.12	0.00	0.06	0.01
Vegetables and Fruit	-0.08	-0.03	0.05	0.00	-0.32	0.30	0.08
Other Food	0.06	0.04	0.05	0.02	0.08	-0.29	0.03
Food Away	-0.13	-0.01	0.09	0.01	0.04	0.07	-0.07

FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 11: GOIANIA

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bze.	-0.12	0.05	0.04	0.08	-0.13	0.09	-0.13
Manioc and Beans	0.05	-0.21	0.08	0.02	0.03	-0.03	0.07
Beef	0.02	0.06	-0.39	0.03	0.08	0.16	0.03
Other Meat	0.08	0.02	0.05	-0.27	0.10	0.10	-0.08
Vegetables and Fruit	-0.11	0.03	0.11	0.09	-0.34	0.15	0.08
Other Food	0.02	-0.01	0.07	0.03	0.05	-0.18	0.01
Food Away	-0.06	0.04	0.02	-0.05	0.05	0.03	-0.03

(-0.33) calculated from parameters of a Florida-PI model, and estimated using cross-country data by Theil et al., (1989). The own-price elasticities for the seven food groups reported in this study are in sharp contrast with the much higher price elasticities of demand for food groups in Brazil reported by Strauss et al. (1992). Cross-price elasticities of demand are in general small, revealing that the substitution and complementary effect, discussed in Section 4.2, are equal to less than one-fifth the corresponding own-price effect, on average. It is worthwhile to note that the values for the price elasticities reported in this study are in line with the price elasticities reported in other demand studies for various countries (Selvanathan, 1993; Theil et al., 1989).

CHAPTER 5

SUMMARY AND CONCLUSIONS

The objective of this research was to study the structure of demand for food in Brazil. Following a review of demand models used in empirical analysis, a justification for selecting the Florida model was presented. Two versions of the model, the Florida-PI and the Florida-Slutsky were used to estimate the demand for food and demand for seven food groups conditional on food expenditures, respectively.

The data used in this study is a cross-section of Brazilian households containing information on expenditure and consumption of 59 food goods. The prices paid by households were calculated by dividing expenditure by the quantity purchased of each food good. Given that many households did not report expenditures in a number of food goods during the surveyed period, their respective prices could not be calculated. Estimation of the model with all observations required that information on all prices be available. To cope with this problem, two alternative methods were used in this study. The model was firstly estimated using all observations; for those food groups for

which prices were not available, implicit prices for each household were calculated. Secondly, the model was estimated by deleting the observations containing the missing prices.

Estimation of the conditional demand model was carried out by application of the Maximum Likelihood approach. Interpretation of the parameter estimates and asymptotic standard errors was provided, along with statistical tests of significance (Section 4.3). Parameter estimates were used to calculate unconditional, conditional income and price elasticities. A discussion on the interpretation of the elasticities was provided in Sections 4.4 through 4.6.

This study shows that the calculated income and price elasticities are different for the seven food groups considered. All unconditional income elasticities are smaller than one showing that there are no luxury goods among the seven food groups. Income elasticities vary with the level of income, but at least for the range of total expenditures considered, no inferior good was found. Conditional on food expenditures, the groups containing staples exhibit elasticities smaller than one, as opposed to the groups containing non-staples that exhibit elasticities larger than one, indicating that expenditure on those goods grows proportionally more than the expenditure on food. The

price elasticities for the seven food groups are small in absolute value, indicating a low quantity response to price changes.

This study differs from previous analysis in three aspects: 1) Food goods were aggregated in seven well defined groups. The groups were formed as to allow the study to focus on particular food groups, namely wheat based and meat products, 2) the structure of demand was analyzed separately for 11 representative regions of Brazil using the most recent cross-sectional data available from a Brazilian household expenditure survey (HES). The HESs have been carried out in Brazil in intervals of approximately 10 years, and 3) two versions of the Florida model, developed by Theil, Chung and Seale (1989) were used. The model was estimated a total of 13,485 observations.

It is worthwhile to note that the Brazilian HES was limited to metropolitan areas. Although those areas are responsible for a large proportion of private consumption, consumption patterns in rural areas were not taken into account in this study. The survey was conducted during a period of high inflation in Brazil. Although a careful use of price deflators may have minimized the inflationary effect, there could have been some impact of inflation on consumption patterns not accounted for in this study.

As has been noted, Brazil is undergoing a period of rapid economic change towards a market oriented economy. Trade restrictions have been phased out, and supply management policies have altered the availability of food goods as well as relative prices. Extensions of this research calls for analysis of time series and the new cross-section data coming out in 1996.

APPENDIX A

THE DIFFERENTIAL APPROACH TO DEMAND ANALYSIS

In this section, the differential approach to demand analysis (Theil, 1975-6; Barten, 1977) is used to derive the a general differential demand system. Setting up the maximization problem. Consumers maximize utility subject to a budget constraint

$$\begin{aligned} \text{(A.1)} \quad & \text{MAX } U = u(q) \\ & \text{S.T. } p'q = m, \end{aligned}$$

where $u(.)$ is a function that is assumed to be quasi-concave twice differentiable. The utility function relates consumer's utility U to a vector of quantities of goods q . The vector of prices p is assumed exogenous. Total expenditure m represents total expenditure on all goods. The first order conditions (FOC) for utility maximization are

$$\text{(A.2)} \quad \frac{\delta U}{\delta q} = \lambda p, \text{ and}$$

$$\text{(A.3)} \quad p'q = x,$$

where λ is the Lagrangean multiplier that represents the marginal utility of income,

$$(A.4) \quad \frac{\delta U}{\delta x} = \lambda.$$

The second order conditions for maximum requires that the Hessian matrix of second derivatives of the utility function with respect to quantities be negative semidefinite,

$$(A.5) \quad H = \left[\frac{\delta^2 U}{\delta q_i \delta q_j} \right] \leq 0.$$

Solution to the utility maximization problem yields a set of demand equations,

$$(A.6) \quad q_i = q_i(x, p), \quad i = 1, \dots, n,$$

where quantity consumed of good i is a function of income x and a vector p of prices $[p_1, p_2, \dots, p_n]'$.

Total differentiation of (A.6) yields

$$(A.7) \quad dq_i = \frac{\delta q_i(x, p)}{\delta x} dx + \sum_{j=1}^n \frac{\delta q_i(x, p)}{\delta p_j} dp_j.$$

Note that

$$(A.8) \quad d(\log x) = \frac{1}{x} dx, \quad xd(\log x) = dx, \text{ and that}$$

$$(A.9) \quad d(\log p_j) = \frac{1}{p_j} dp_j, \quad p_j d(\log p_j) = dp_j.$$

Substituting (A.8) and (A.9) into (A.7)

$$(A.10) \quad dq_i = \frac{\delta q_i(x, P)}{\delta x} xd(\log x) + \sum_{j=1}^n p_j \frac{\delta q_i(x, P)}{\delta p_j} d(\log p_j).$$

Multiplying both sides of (A.10) by $\frac{p_i}{x}$ yields

$$(A.11) \quad w_i d(\log q_i) = \frac{\delta p_i q_i(x, P)}{\delta x} d(\log x) + \sum_{j=1}^n \frac{p_i p_j}{x} \frac{\delta q_i(x, P)}{\delta p_j} d(\log p_j).$$

Defining

$$(A.12) \quad \theta_i = \frac{\delta p_i q_i(x, P)}{\delta x}$$

as the marginal share of income, and substituting into (A.11) yields

$$(A.13) \quad w_i d(\log q_i) = \theta_i d(\log x) + \sum_{j=1}^n \frac{p_i p_j}{x} \frac{\delta q_i(x, P)}{\delta p_j} d(\log p_j).$$

The term

$$(A.14) \quad \frac{\delta q_i(x, P)}{\delta p_j}$$

can be replaced from the solution to a set of differential equations of the FOC. Total differentiation of FOC and writing in matrix notation yields Barten's fundamental matrix

$$(A.15) \quad \begin{bmatrix} U & P \\ P' & 0 \end{bmatrix} \begin{bmatrix} \frac{dq}{dx} & \frac{dq}{dp'} \\ \lambda & \frac{dU}{dp'} \end{bmatrix} = \begin{bmatrix} 0 & \lambda I \\ 1 & -q' \end{bmatrix}$$

Solving for

$$(A.16) \quad \frac{\delta q_i}{\delta p_i} = \lambda U^{ij} - \phi x \frac{\delta q_i}{\delta x} \frac{\delta q_j}{\delta x} \frac{\delta q_i}{\delta x} q_j$$

and substituting into (A.13) gives

$$(A.17) \quad w_i d(\log q_i) = \theta_i d(\log x) +$$

$$\sum_{n=1}^n \left(\frac{p_i p_j}{x} \lambda U^{ij} - \phi \frac{\delta p_i q_i(x, P)}{\delta x} \frac{\delta p_j q_j(x, P)}{\delta x} - \frac{\delta p_i q_i(x, P)}{\delta x} \frac{p_j q_j}{x} \right) d(\log p_j).$$

Multiplying both sides by $\frac{\phi}{\phi}$, and rearranging terms

$$(A.18) \quad w_i d(\log q_i) = \theta_i d(\log x) + \sum_{j=1}^n (\phi \theta_{ij} - \phi \theta_i \theta_j - \theta_i w_j) d(\log p_j),$$

or

$$(A.19) \quad w_i d(\log q_i) = \theta_i \left[d(\log x) - \sum_{j=1}^n w_j d(\log p_j) \right] + \phi \sum_{j=1}^n (\theta_{ij} - \theta_i \theta_j) d(\log p_j).$$

Given that

$$(A.20) \quad d(\log x) - \sum_{j=1}^n w_j d(\log p_j) = d(\log Q),$$

equation (A.19) becomes

$$(A.21) \quad w_i d(\log q_i) = \theta_i d(\log Q) + \phi \sum_{j=1}^n (\theta_{ij} - \theta_i \theta_j) d(\log p_j).$$

The $n \times n$ matrix of Slutsky coefficients

$$(A.22) \quad \pi_{ij} = \phi (\theta_{ij} - \theta_i \theta_j),$$

is symmetric ($\pi_{ij} = \pi_{ji}$) and negative semidefinite of order $n-1$.

1. The full matrix is singular, due to

$$(A.23) \quad \sum_{j=1}^n \pi_{ij} = 0, \text{ for } i=1, \dots, n,$$

implying that the homogeneity condition of demand equations holds.

A.1 Preference Independence

Under preference independence, consumers utility can be represented by

$$(A.24) \quad U = \sum_{i=1}^n u_i(q_i).$$

The marginal utility of good i does not depend on consumption of good j , $i \neq j$. The Hessian is diagonal given that the second cross-price derivatives of the utility function equal zero, implying that the matrix of substitution terms

$$(A.25) \quad \theta_{ij} = \frac{\lambda_{ij}}{\phi x} p_i u_{ij} p_j,$$

is diagonal, and that

$$(A.26) \quad \sum_{j=1}^n \theta_{ij} = \theta_i.$$

Thus, the matrix of Slutsky coefficients takes the form

$$(A.27) \quad \pi_{ij} = \phi \theta_i (1 - \theta_i) \text{ if } i = j, \text{ and}$$

$$(A.28) \quad \pi_{ij} = \phi \theta_i \theta_j \text{ if } i \neq j.$$

Thus, under preference independence, the general demand equation becomes

$$(A.29) \quad w_i d(\log q_i) = \theta_i d(\log Q) + \phi \theta_i d\left(\log \frac{p_j}{p^*}\right),$$

A.1.1 Income and Price Elasticities

Dividing both sides of the demand equation (A.29) of good i by w_i yields

$$(A.30) \quad d(\log q_i) = \frac{\theta_i}{w_i} d(\log Q) + \frac{\phi \theta_i}{w_i} d\left(\log \frac{p_j}{p^*}\right).$$

Differentiation (A.30) with respect to real income and deflated prices yields

$$(A.31) \quad \varepsilon_{i1} = \frac{\theta_i}{w_i},$$

$$(A.32) \quad \varepsilon_{ii}^F = \frac{\phi \theta_i}{w_i},$$

the income and Frisch own-price elasticities, respectively. The Frisch own-price elasticity represents changes in the quantity consumed of good i for changes in its price, holding marginal utility of income constant.

Slutsky own-price elasticities, holding constant real income $d(\log Q) = 0$, are

$$(A.33) \quad \varepsilon_{ii}^S = \frac{\phi \theta_i (1 - \theta_i)}{w_i}.$$

Cournot own-price elasticities are obtained by subtracting θ from Slutsky elasticities, yielding

$$(A.34) \quad \varepsilon_{ii}^c = \frac{\theta_i (\phi - \phi \theta_i - 1)}{w_i}.$$

APPENDIX B

TABLE B.1: EXPENDITURE DATA
(59 FOOD GOODS)

This table presents an example of how data are organized in the files. The columns from the left to the right contain: observation number, household size, city weight, city/county weight, day, month, year of the survey, household identification code, type or record, frequency of purchase, total expenditure, and expenditures on 59 goods belonging to the food group.

TABLE B.2: PRICE DATA
(59 FOOD GOODS)

This table presents an example of how data are organized in the files. The columns from the left to the right contain: observation number, household size, city weight, city/county weight, day, month, year of the survey, household identification code, type or record, frequency of purchase, and prices paid for 59 goods belonging to the food group.

TABLE 8.4 HOUSEHOLD CHARACTERISTICS AND PRICE INDEXES ON 1,000 ITEMS, TWO COUNTRIES, 1987-1990 (first five assets)

TABLE B.3: EXPENDITURE AND PRICE DATA
(SEVEN FOOD GROUPS)

This table presents an example of how data are organized in the files. The columns from the left to the right contain: household size, total expenditure, total expenditure on food, expenditure on the seven food groups, defined in Chapter 3, price indices for the seven food goods, defined in Chapter 2, city weight, city/county weight, month of Purchase, and frequency of purchase.

TABLE B3: CURTISA, SEVEN FOOD GROUPS, HOUSEHOLD SIZE, TOTAL EXPENDITURE, FOOD EXPENDITURE, BUDGET SHARES, PRICE INDICES, WEIGHTS, MONTH AND FREQUENCY (first five pages)

Size	Total Exp.	Food Exp.	Wheat	Maize	Beef	O Meat	Vegetable	F. Food	F. Army	Wheat	Maize	Beef	O Meat	Vegetable	F. Food	F. Army	Weights 1	Weights 2	Months	Frequency	
4	4307.47	2115.84	0.264	0.074	0.020	0.085	0.023	0.314	0.020	0.020	-0.039	-0.009	0.008	-0.021	-0.264	0.000	326	0	3	76	
5	12832.55	4030.87	0.634	0.119	0.001	0.101	0.155	0.347	0.211	0.011	-0.059	-0.046	-0.007	-0.029	-0.111	-0.108	326	0	3	108	
6	8123.37	2456.26	0.178	0.005	0.000	0.467	0.035	0.260	0.035	-0.158	-0.009	0.000	-0.120	-0.035	-0.108	-0.033	326	0	3	97	
7	7258.96	4298.86	0.229	0.077	0.000	0.125	0.054	0.216	0.034	-0.027	0.034	-0.012	0.006	-0.006	-0.135	-0.048	326	0	3	96	
8	2259.33	1011.11	0.121	0.011	0.000	0.454	0.016	0.141	0.016	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	326	0	3	184	
9	42005.33	9695.51	0.092	0.048	0.000	0.227	0.058	0.345	0.056	-0.020	-0.030	-0.016	0.007	-0.009	-0.167	-0.032	326	0	3	170	
3	15026.26	7108.7	0.149	0.060	0.213	0.161	0.028	0.345	0.026	0.103	-0.001	-0.001	-0.019	-0.048	0.084	-0.032	326	0	3	110	
5	5937.38	2140.76	0.048	0.000	0.178	0.368	0.072	0.165	-0.027	0.000	-0.076	-0.137	-0.014	-0.033	-0.027	326	0	4	61		
2	4884.07	2534.08	0.158	0.169	0.074	0.148	0.021	0.430	0.000	-0.011	-0.019	-0.079	-0.045	-0.015	-0.158	0.000	326	0	4	69	
3	1245.43	1014.33	0.121	0.014	0.000	0.454	0.016	0.141	0.016	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	326	0	4	80	
4	2067.79	2243.9	0.069	0.018	0.376	0.072	0.035	0.336	0.016	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	326	0	4	80	
6	2007.71	753.86	0.101	0.018	0.301	0.000	0.002	0.000	0.000	0.000	-0.001	-0.001	-0.001	-0.001	-0.001	0.000	326	0	4	92	
4	1707.67	709.08	0.083	0.067	0.000	0.420	0.000	-0.048	-0.017	0.000	-0.000	-0.000	-0.000	-0.000	-0.001	0.000	326	0	4	39	
3	1429.97	2614.46	0.149	0.000	0.252	0.179	0.090	0.290	0.049	-0.088	-0.000	-0.032	-0.098	-0.023	-0.229	-0.083	326	0	5	35	
4	1429.97	2614.46	0.149	0.000	0.252	0.179	0.090	0.290	0.049	-0.088	-0.000	-0.032	-0.098	-0.023	-0.229	-0.083	326	0	5	85	
2	10064.63	2419.87	0.045	0.056	0.000	0.303	0.074	0.277	0.044	-0.030	0.084	0.000	-0.077	-0.016	-0.204	-0.217	326	0	5	103	
3	32970.17	11351.16	0.080	0.142	0.088	0.087	0.040	0.303	0.291	0.038	0.116	0.031	-0.019	-0.001	-0.132	0.019	265	0	3	177	
5	2508.02	1153.39	0.050	0.000	0.000	0.419	0.051	0.125	0.000	0.000	0.000	0.000	0.000	0.000	-0.000	-0.000	265	0	3	148	
6	1806.83	4638.17	0.271	0.065	0.211	0.062	0.015	0.356	0.000	0.115	0.015	0.015	0.015	0.015	0.015	0.015	265	0	3	138	
5	7996.47	4149.84	0.209	0.234	0.000	0.115	0.015	0.402	0.000	0.148	0.073	0.000	-0.022	0.002	0.067	0.000	265	0	3	66	
4	5648.16	3038.4	0.212	0.015	0.089	0.260	0.065	0.317	0.022	-0.079	-0.019	-0.055	0.017	-0.024	-0.175	-0.028	265	0	3	103	
3	9262.36	2120.63	0.285	0.240	0.198	0.000	0.035	0.324	0.000	0.119	-0.233	-0.011	0.000	-0.012	-0.271	0.000	265	0	3	87	
4	11259.72	2358.64	0.045	0.061	0.000	0.345	0.016	0.141	0.016	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.000	265	0	4	101	
5	8210.34	2443.3	0.213	0.000	0.000	0.395	0.026	0.319	0.000	0.028	0.000	0.000	-0.038	-0.014	-0.186	-0.042	265	0	4	94	
4	10975.89	3887.62	0.137	0.049	0.000	0.088	0.042	0.283	0.401	-0.020	0.005	0.000	0.009	-0.006	0.113	-0.089	265	0	4	68	
2	1720.77	2250.56	0.381	0.158	0.000	0.000	0.006	0.454	0.000	-0.013	-0.007	0.000	0.000	0.000	-0.008	0.154	0.000	265	0	4	63
6	3213.49	8117.1	0.245	0.063	0.213	0.174	0.022	0.286	0.101	0.175	0.000	0.000	0.000	0.000	-0.005	-0.046	265	0	5	109	
2	5390.85	3251.11	0.154	0.005	0.233	0.000	0.027	0.312	0.189	-0.050	-0.048	-0.086	0.000	-0.002	-0.113	-0.029	265	0	5	83	
5	1187.63	4640.49	0.110	0.028	0.183	0.144	0.043	0.433	0.059	0.004	-0.020	0.100	0.015	-0.020	-0.089	0.007	265	0	5	115	
6	3710.86	1654.47	0.087	0.002	0.350	0.008	0.116	0.340	0.043	0.014	-0.045	0.344	-0.001	0.132	-0.048	-0.029	339	0	6	169	
3	12574.69	5422.97	0.124	0.103	0.133	0.132	0.049	0.405	0.059	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	-0.002	339	0	6	121	
2	1027.68	718.42	0.095	0.325	0.000	0.000	0.037	0.472	0.000	-0.000	-0.046	0.000	0.000	-0.011	-0.205	0.000	339	0	6	25	
6	49208.96	2530.43	0.217	0.052	0.000	0.166	0.176	0.370	0.019	-0.030	-0.037	0.000	0.283	-0.034	-0.083	-0.029	339	0	6	122	
8	11259.72	2358.64	0.045	0.061	0.000	0.468	0.016	0.141	0.016	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	0.000	339	0	6	124	
3	9602.56	2711.14	0.195	0.000	0.000	0.446	0.145	0.125	0.000	-0.073	-0.061	-0.020	-0.001	-0.020	-0.018	0.000	339	0	7	93	
4	7793.66	1604.66	0.091	0.120	0.148	0.045	0.234	0.339	0.022	-0.037	-0.213	-0.084	-0.050	-0.048	-0.327	-0.049	339	0	7	93	
5	20977.99	6400.86	0.175	0.145	0.088	0.051	0.005	0.462	0.043	0.079	0.179	-0.004	0.039	-0.001	0.425	0.009	339	0	7	129	
3	11372.01	3330.85	0.128	0.008	0.243	0.020	0.035	0.444	0.042	-0.099	-0.050	-0.056	-0.003	-0.005	0.011	-0.056	339	0	7	103	
2	22799.5	2246.82	0.067	0.017	0.489	0.131	0.041	0.131	-0.041	0.000	-0.055	0.008	-0.006	-0.006	-0.067	-0.201	339	0	7	74	
5	5208.85	1330.84	0.116	0.062	0.179	0.139	0.065	0.000	-0.046	-0.075	-0.010	-0.008	-0.006	-0.020	-0.254	0.000	339	0	8	82	
6	5633.83	1042.11	0.081	0.000	0.000	0.474	0.003	0.407	0.000	-0.011	0.000	0.000	0.000	0.000	-0.160	0.000	339	0	8	77	
7	9400.26	5989.65	0.062	0.116	0.104	0.124	0.062	0.472	0.000	0.014	0.027	0.021	-0.011	-0.020	0.243	0.000	339	0	8	135	
1	21683.3	1722.19	0.036	0.025	0.000	0.000	0.000	0.000	0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.002	0.211	339	0	8	98	
1	21683.3	1722.19	0.036	0.025	0.000	0.000	0.000	0.000	0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.002	0.211	339	0	8	98	
1	16504.17	8554.35	0.165	0.097	0.115	0.062	0.188	0.352	0.000	-0.040	-0.043	0.006	-0.019	0.018	0.046	0.000	362	333	6	152	
1	30506.02	5991.78	0.032	0.024	0.283	0.005	0.053	0.228	0.286	-0.005	-0.003	-0.001	0.012	0.000	-0.017	-0.001	0.043	362	333	6	167
2	5443.24	1219.22	0.121	0.072	0.305	0.198	0.007	0.404	0.017	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002	0.002	362	333	7	119	
3	58443.24	7141.87	0.039	0.081	0.346	0.213	0.072	0.000	0.558	-0.007	0.000	0.228	0.051	0.047	0.011	0.055	362	333	7	151	
3	65248.09	10379.24	0.031	0.040	0.000	0.292	0.145	0.308	0.292	-0.045	-0.017	-0.037	-0.005	0.003	-0.025	0.139	362	333	7	238	
4	26185.31	2715.26	0.153	0.033	0.000	0.000	0.055	0.247	0.000	0.087	-0.008	0.000	0.026	-0.003	0.086	0.000	362	333	7	116	

TABLE B3. CURTIBA, SEVEN FOOD GROUPS, HOUSEHOLD SIZE, TOTAL EXPENDITURE, BUDGET SHARES, PRICE INDEXES, WEIGHTS, MONTH AND FREQUENCY (first five pages)

Size	Total Exp.	Food Exp.	Wheat	Meat	Bread	O. Meat	Vegetable	O. Food	P. Food	P. Meat	Wheat	Meat	Bread	O. Meat	Vegetable	O. Food	P. Food	Wheat	Meat	Frequency
5	32367.15	5445.24	0.230	0.038	0.000	0.000	0.000	0.000	0.419	0.260	0.090	0.018	0.000	0.000	0.000	0.049	0.441	398	338	3
5	18831.26	8899.77	0.130	0.047	0.000	0.040	0.055	0.500	0.050	0.188	0.078	0.021	0.000	0.082	-0.005	0.005	-0.049	398	338	3
5	72452.82	13985.33	0.177	0.047	0.000	0.040	0.055	0.500	0.050	0.188	0.078	0.021	0.000	0.082	-0.005	0.005	-0.049	398	338	3
6	34487.24	3274.41	0.200	0.019	0.217	0.018	0.019	0.253	0.408	0.000	0.000	-0.002	-0.018	-0.011	0.015	0.070	0.368	338	338	4
2	4649.8	1899.98	0.230	0.169	0.000	0.078	0.144	0.063	-0.068	-0.068	-0.068	-0.068	-0.068	-0.068	-0.068	-0.068	-0.068	398	338	4
5	17754.96	4824.73	0.150	0.000	0.355	0.115	0.063	0.186	0.130	-0.007	0.000	0.127	0.045	-0.014	-0.037	0.032	0.000	398	338	5
8	19148.37	1658.33	0.056	0.355	0.000	0.144	0.022	0.498	0.075	-0.018	0.018	0.035	0.155	-0.073	-0.052	0.054	-0.137	398	338	5
8	34623.57	7559.48	0.056	0.355	0.000	0.144	0.022	0.498	0.075	-0.018	0.018	0.035	0.155	-0.073	-0.052	0.054	-0.137	398	338	5
3	50511.64	2444.42	0.182	0.000	0.375	0.018	0.378	0.000	-0.051	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	398	338	6
4	47486.83	1919.75	0.057	0.355	0.000	0.115	0.063	0.186	0.130	-0.007	0.000	0.127	0.045	-0.014	-0.037	0.032	0.000	398	338	6
4	74486.83	1919.75	0.057	0.355	0.000	0.115	0.063	0.186	0.130	-0.007	0.000	0.127	0.045	-0.014	-0.037	0.032	0.000	398	338	6
5	59624.4	12386.11	0.047	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	398	338	7
3	18337.78	2644.75	0.117	0.000	0.268	0.052	0.170	0.284	0.074	-0.068	0.000	0.209	-0.003	0.078	0.109	0.021	0.320	272	272	8
5	22126.52	4811.81	0.114	0.000	0.268	0.052	0.170	0.284	0.074	-0.068	0.000	0.209	-0.003	0.078	0.109	0.021	0.320	272	272	8
5	26339.61	10044.24	0.086	0.062	0.213	0.073	0.105	0.330	0.088	-0.021	-0.021	-0.021	-0.021	-0.021	-0.021	-0.021	-0.021	272	272	8
4	12741.86	4242.48	0.144	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	272	272	8
4	22460.12	11378.25	0.040	0.045	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	272	272	8
4	13317.27	5339.97	0.199	0.174	0.003	0.051	0.066	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	272	272	7
5	4105.42	1650.78	0.213	0.063	0.000	0.255	0.017	0.390	0.043	-0.081	-0.081	-0.081	-0.081	-0.081	-0.081	-0.081	-0.081	272	272	7
5	14105.42	1650.78	0.213	0.063	0.000	0.255	0.017	0.390	0.043	-0.081	-0.081	-0.081	-0.081	-0.081	-0.081	-0.081	-0.081	272	272	7
6	19343.59	7197.98	0.116	0.000	0.166	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	272	272	7
4	13329.83	5042.3	0.137	0.178	0.028	0.115	0.183	0.068	0.366	0.170	0.036	0.005	0.168	-0.061	-0.015	-0.002	0.187	320	272	8
4	25936.98	5779.39	0.108	0.025	0.175	0.028	0.115	0.183	0.068	0.366	0.170	0.036	0.005	0.168	-0.061	-0.015	-0.002	320	272	8
1	897.48	441.22	0.048	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	320	272	8
4	5843.67	1979.81	0.444	0.051	0.003	0.109	0.031	0.183	0.108	0.368	-0.051	-0.044	-0.051	-0.044	-0.051	-0.044	-0.051	319	271	8
2	14310.42	3511.52	0.082	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	319	271	8
2	24210.42	3511.52	0.082	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	319	271	8
5	16847.47	1628.11	0.189	0.000	0.478	0.054	0.037	0.057	0.207	0.066	0.000	-0.155	-0.058	-0.004	-0.015	-0.296	319	271	8	
3	15586.83	4253.17	0.125	0.000	0.143	0.321	0.122	0.265	0.048	0.022	0.000	-0.141	0.005	-0.027	-0.012	-0.235	319	271	8	
5	17682.85	4818.45	0.101	0.000	0.143	0.321	0.122	0.265	0.048	0.022	0.000	-0.141	0.005	-0.027	-0.012	-0.235	319	271	8	
2	3107.78	8327.18	0.056	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	319	271	8
2	3004.57	1473.24	0.067	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	319	271	7
3	6812.56	3322.2	0.102	0.122	0.008	0.357	0.038	0.274	0.000	-0.040	-0.034	-0.097	-0.080	-0.021	-0.075	-0.107	0.000	319	271	8
4	15681.49	2835.82	0.138	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	319	271	8
5	33722.31	5011.86	0.034	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	319	271	8
4	3117.47	1465.24	0.056	0.059	0.000	0.020	0.089	0.079	0.000	-0.019	-0.019	-0.019	-0.019	-0.019	-0.019	-0.019	-0.019	319	271	8
7	13000.44	4657.79	0.156	0.005	0.104	0.157	0.138	0.030	0.000	-0.010	-0.010	-0.010	-0.010	-0.010	-0.010	-0.010	-0.010	319	271	8
3	46489.91	8296.17	0.041	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	319	271	8
3	11901.39	3730.06	0.061	0.000	0.007	0.076	0.072	0.235	0.538	0.011	0.000	-0.010	-0.010	-0.010	-0.010	-0.010	-0.010	319	271	8
8	18815.25	10862.48	0.063	0.079	0.002	0.045	0.078	0.458	0.155	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	278	236	3
2	16815.25	2725.15	0.063	0.130	0.020	0.163	0.131	0.358	0.037	-0.022	-0.022	-0.022	-0.022	-0.022	-0.022	-0.022	-0.022	278	236	3
4	2740.56	5624.82	0.063	0.000	0.000	0.040	0.023	0.375	0.000	0.024	0.000	-0.265	-0.028	-0.028	-0.028	-0.028	-0.028	278	236	3
4	2740.56	5624.82	0.063	0.000	0.000	0.040	0.023	0.375	0.000	0.024	0.000	-0.265	-0.028	-0.028	-0.028	-0.028	-0.028	278	236	3
8	16400.56	5624.82	0.144	0.154	0.140	0.031	0.047	0.465	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	278	236	3
4	82148.58	10068.3	0.057	0.000	0.026	0.000	0.129	0.011	0.000	0.000	-0.032	0.030	-0.089	-0.018	-0.089	-0.018	-0.089	278	236	4
5	13045.77	6992.73	0.182	0.068	0.000	0.248	0.010	0.356	0.006	-0.032	0.000	-0.032	0.000	-0.032	0.000	-0.032	0.000	278	236	4
4	45537.87	4402.11	0.104	0.015	0.187	0.033	0.083	0.303	0.213	0.105	0.018	0.026	-0.007	-0.008	-0.007	-0.008	-0.007	278	236	4
5	49168.04	5884.21	0.104	0.020	0.398	0.073	0.064	0.324	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	278	236	5

TABLE B3. CURTIBA, SEVEN FOOD GROUPS, HOUSEHOLD SIZE, TOTAL EXPENDITURE, FOOD EXPENDITURE, BUDGET SHARES, PRICE INDICES, WEIGHTS, MONTH AND FREQUENCY (first five pages)

Size	Total Exp.	Food Exp.	Wheat	Meat	Bread	O. Meat	Veg/Prod	O. Prod	P. Army	Wheat	Meat	Bread	O. Meat	Veg/Prod	O. Prod	P. Army	Weight 1	Weight 2	Month	Frequency
5	108712.2	4473.14	0.151	0.000	0.619	0.061	0.000	0.000	0.000	0.000	0.000	0.847	0.020	0.000	0.000	0.000	370	314	3	126
7	37529.18	19136.05	0.033	0.000	0.108	0.141	0.042	0.235	0.411	0.023	0.000	0.000	0.054	0.085	0.011	0.027	0.367	314	3	252
5	25091.49	7864.06	0.068	0.035	0.218	0.186	0.128	0.387	0.387	0.013	-0.025	-0.033	0.123	-0.038	-0.038	-0.037	314	314	3	183
4	42588.48	5480.95	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	314	314	4	178
3	31071.18	5480.95	0.070	0.006	0.089	0.380	0.122	0.329	0.010	-0.013	-0.007	0.044	0.244	-0.017	0.172	-0.016	314	314	4	189
4	31071.18	5480.95	0.070	0.006	0.089	0.380	0.122	0.329	0.010	-0.013	-0.007	0.044	0.244	-0.017	0.172	-0.016	314	314	4	189
3	7030.95	4681.38	0.144	0.106	0.128	0.146	0.115	0.382	0.000	-0.062	-0.064	-0.101	-0.081	-0.068	-0.204	0.000	314	314	4	141
4	6860.22	3486.49	0.203	0.102	0.108	0.118	0.112	0.343	0.016	-0.048	-0.048	-0.039	-0.010	-0.038	-0.118	-0.022	314	314	5	122
5	13827.9	5827.19	0.077	0.108	0.231	0.046	0.084	0.354	0.122	0.013	0.111	0.104	-0.020	0.015	0.372	-0.074	314	314	5	125
5	17816.38	5827.19	0.077	0.108	0.231	0.046	0.084	0.354	0.122	0.013	0.111	0.104	-0.020	0.015	0.372	-0.074	314	314	5	125
4	24375.05	7120.46	0.039	0.178	0.070	0.032	0.099	0.204	0.475	-0.015	-0.015	-0.020	-0.020	-0.020	0.042	-0.161	314	314	5	109
5	40873.65	6408.83	0.184	0.067	0.278	0.057	0.096	0.214	0.132	0.021	0.100	0.143	-0.020	0.027	0.042	-0.054	340	289	3	138
4	40873.65	6408.83	0.184	0.067	0.278	0.057	0.096	0.214	0.132	0.021	0.100	0.143	-0.020	0.027	0.042	-0.054	340	289	3	138
4	40873.65	6408.83	0.184	0.067	0.278	0.057	0.096	0.214	0.132	0.021	0.100	0.143	-0.020	0.027	0.042	-0.054	340	289	3	138
4	40873.65	6408.83	0.184	0.067	0.278	0.057	0.096	0.214	0.132	0.021	0.100	0.143	-0.020	0.027	0.042	-0.054	340	289	3	138
2	11337.18	3264.37	0.155	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	340	289	3	117
2	41438.11	5937.08	0.195	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	340	289	3	131
4	24268.22	7789.92	0.068	0.072	0.000	0.072	0.188	0.268	0.000	0.330	-0.028	0.000	-0.028	-0.028	-0.028	-0.028	340	289	4	90
4	7440.73	5014.26	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	340	289	4	126
5	5043.38	1020.92	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	340	289	4	56
4	3507.74	1622.69	0.156	0.000	0.014	0.422	0.132	0.137	0.000	-0.088	0.000	0.000	0.000	0.000	0.000	0.000	340	289	4	178
3	16253.74	4211.19	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	340	289	4	137
3	16253.74	4211.19	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	340	289	4	137
6	28179.29	3622.23	0.106	0.082	0.181	0.035	0.218	0.284	0.066	-0.011	0.068	-0.049	-0.030	-0.023	-0.154	-0.111	340	289	5	172
3	21219.82	4680.33	0.116	0.008	0.384	0.124	0.041	0.387	0.030	-0.011	0.000	0.116	-0.027	-0.027	-0.148	-0.145	340	289	5	122
5	8673.87	3811.41	0.076	0.069	0.027	0.068	0.053	0.226	0.421	-0.032	-0.069	-0.054	-0.042	-0.010	-0.138	-0.096	340	289	5	127
5	37466.3	8739.82	0.077	0.081	0.178	0.052	0.104	0.393	0.137	0.009	0.002	0.015	-0.007	0.018	0.148	-0.045	340	289	5	170
5	10796.43	1970.85	0.107	0.151	0.225	0.000	0.065	0.331	0.080	0.061	0.147	0.160	0.000	0.065	0.164	0.027	300	306	3	84
5	10796.43	1970.85	0.107	0.151	0.225	0.000	0.065	0.331	0.080	0.061	0.147	0.160	0.000	0.065	0.164	0.027	300	306	3	84
2	5657.88	1920.92	0.091	0.070	0.048	0.143	0.167	0.080	0.000	-0.037	-0.017	0.000	-0.037	-0.017	-0.037	-0.037	300	306	3	90
10	18819.12	6721	0.100	0.129	0.072	0.052	0.100	0.445	0.103	-0.037	-0.017	0.000	-0.037	-0.017	-0.037	-0.037	300	306	3	101
4	6434.15	3591.93	0.051	0.000	0.071	0.080	0.056	0.048	0.337	-0.033	0.000	0.002	-0.011	-0.017	0.002	0.254	300	306	4	86
4	6434.15	3591.93	0.051	0.000	0.071	0.080	0.056	0.048	0.337	-0.033	0.000	0.002	-0.011	-0.017	0.002	0.254	300	306	4	86
4	6434.15	3591.93	0.051	0.000	0.071	0.080	0.056	0.048	0.337	-0.033	0.000	0.002	-0.011	-0.017	0.002	0.254	300	306	4	86
4	6434.15	3591.93	0.051	0.000	0.071	0.080	0.056	0.048	0.337	-0.033	0.000	0.002	-0.011	-0.017	0.002	0.254	300	306	4	86
2	6512.8	1511.38	0.112	0.000	0.047	0.087	0.181	0.016	0.329	0.100	-0.006	0.000	0.054	0.010	-0.071	-0.033	300	306	5	102
4	3233.67	7046.43	0.044	0.000	0.180	0.113	0.016	0.329	0.100	-0.006	0.000	0.054	0.010	-0.071	-0.033	300	306	5	102	
5	14683.32	4491.65	0.044	0.000	0.084	0.070	0.145	0.340	0.000	-0.023	-0.061	-0.038	-0.012	-0.018	-0.268	0.000	300	306	5	95
5	14683.32	4491.65	0.044	0.000	0.084	0.070	0.145	0.340	0.000	-0.023	-0.061	-0.038	-0.012	-0.018	-0.268	0.000	300	306	5	95
2	5044.9	2917.81	0.172	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	300	306	6	94
5	5044.9	2917.81	0.172	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	300	306	6	94
4	23228.98	1013.3	0.125	0.192	0.068	0.041	0.040	0.051	0.000	-0.011	0.306	-0.025	0.010	0.003	0.270	0.000	307	261	6	119
4	23228.98	1013.3	0.125	0.192	0.068	0.041	0.040	0.051	0.000	-0.011	0.306	-0.025	0.010	0.003	0.270	0.000	307	261	6	119
2	3484.98	6993.7	0.171	0.068	0.045	0.062	0.072	0.283	0.260	-0.255	-0.002	0.000	0.000	0.000	0.000	0.000	307	261	6	223
2	3484.98	6993.7	0.171	0.068	0.045	0.062	0.072	0.283	0.260	-0.255	-0.002	0.000	0.000	0.000	0.000	0.000	307	261	6	223
3	14334.25	3695.6	0.086	0.069	0.039	0.083	0.000	0.000	0.000	-0.016	-0.004	0.081	-0.001	-0.013	-0.004	0.000	307	261	7	85
5	13151.81	3620.85	0.215	0.161	0.032	0.133	0.044	0.215	0.000	-0.016	-0.004	0.081	-0.001	-0.013	-0.004	0.000	307	261	7	129
3	29432.3	6631.65	0.104	0.046	0.069	0.165	0.086	0.227	0.278	-0.011	-0.013	-0.058	-0.029	-0.048	-0.060	0.000	307	261	7	160
2	10474.35	7631.99	0.116	0.116	0.075	0.089	0.112	0.403	0.104	-0.011	-0.028	-0.081	-0.034	-0.024	-0.028	0.122	307	261	7	140
2	10474.35	7631.99	0.116	0.116	0.075	0.089	0.112	0.403	0.104	-0.011	-0.028	-0.081	-0.034	-0.024	-0.028	0.122	307	261	7	140
4	47613.71	7862.99	0.117	0.026	0.154	0.108	0.108	0.320	0.000	-0.028	-0.028	0.048	0.037	0.068	-0.028	0.098	307	261	7	109
4	47613.71	7862.99	0.117	0.026	0.154	0.108	0.108	0.320	0.000	-0.028	-0.028	0.048	0.037	0.068	-0.028	0.098	307	261	7	109
4	47613.71	7862.99	0.117	0.026	0.154	0.108	0.108	0.320	0.000	-0.028	-0.028	0.048	0.037	0.068	-0.028	0.098	307	261	7	109
4	47613.71	7862.99	0.117	0.026	0.154	0.108	0.108	0.320	0.000	-0.028	-0.028	0.048	0.037	0.068	-0.028	0.098	307	261	7	109

APPENDIX C

DELETED OBSERVATIONS MODEL - PARAMETER ESTIMATES, INCOME AND PRICE ELASTICITIES

In this appendix, parameter of the Florida-Slutsky model, estimated with deleted observations, are reported along with asymptotic standard errors, conditional and unconditional income elasticities, and Slutsky price elasticities.

Table C.1 Florida-Slutsky Model, Parameter Estimates for Each Region of Brazil. Standard Errors in Parenthesis
(*) Parameters not Statistically Different from Zero. Deleted Observations Model

Food Group	Region									
	α									
	RIO DE JANEIRO	PORTO ALAGONE	SÃO JOSE DO RIO NEGRE	SÃO PAULO	GOIÁS	GOIÁS	GOIÁS	GOIÁS	GOIÁS	GOIÁS
Wheat, Pasta and Bread	-0.021 (0.009)	0.152 (0.013)	0.171 (0.009)	0.217 (0.012)	0.139 (0.013)	0.119 (0.007)	0.160 (0.006)	0.169 (0.006)	0.154 (0.010)	0.112 (0.007)
Meat and Beans	0.148 (0.010)	0.108 (0.009)	0.138 (0.014)	0.159 (0.010)	0.110 (0.013)	0.182 (0.012)	0.200 (0.009)	0.216 (0.009)	0.148 (0.010)	0.191 (0.011)
Beef	0.137 (0.020)	0.168 (0.024)	0.107 (0.015)	0.112 (0.016)	0.133 (0.028)	0.189 (0.018)	0.200 (0.018)	0.079 (0.013)	0.140 (0.015)	0.163 (0.014)
Other Meat	0.141 (0.016)	0.133 (0.017)	0.160 (0.014)	0.203 (0.015)	0.108 (0.026)	0.115 (0.013)	0.226 (0.014)	0.214 (0.011)	0.143 (0.012)	0.109 (0.011)
Vegetables and Fruit	0.084 (0.017)	0.086 (0.013)	0.052 (0.014)	0.052 (0.012)	0.158 (0.037)	0.070 (0.012)	0.013 (0.009)	0.034 (0.007)	0.079 (0.013)	0.049 (0.012)
Other Food	0.221 (0.021)	0.300 (0.023)	0.219 (0.021)	0.188 (0.018)	0.184 (0.038)	0.254 (0.019)	0.122 (0.013)	0.195 (0.013)	0.225 (0.016)	0.272 (0.016)
Food Group	Region									
	β									
	RIO DE JANEIRO	PORTO ALAGONE	SÃO JOSE DO RIO NEGRE	SÃO PAULO	GOIÁS	GOIÁS	GOIÁS	GOIÁS	GOIÁS	GOIÁS
Wheat, Pasta and Bread	-0.021 (0.003)	-0.020 (0.004)	-0.028 (0.003)	-0.032 (0.004)	-0.021 (0.004)	-0.013 (0.003)	-0.025 (0.002)	-0.024 (0.002)	-0.021 (0.002)	-0.012 (0.002)
Meat and Beans	-0.025 (0.003)	-0.019 (0.003)	-0.015 (0.005)	-0.030 (0.004)	-0.016 (0.004)	-0.032 (0.004)	-0.035 (0.004)	-0.039 (0.004)	-0.026 (0.002)	-0.033 (0.004)
Beef	* 0.002 (0.007)	* -0.001 (0.008)	* 0.007 (0.005)	* 0.011 (0.006)	* 0.020 (0.009)	* 0.013 (0.006)	* 0.006 (0.007)	* 0.026 (0.005)	* 0.001 (0.005)	* -0.001 (0.005)
Other Meat	* -0.003 (0.005)	* -0.009 (0.006)	* 0.017 (0.005)	* 0.022 (0.006)	* 0 (0.008)	* -0.001 (0.005)	* 0.025 (0.005)	* -0.031 (0.004)	* -0.003 (0.004)	* -0.001 (0.004)
Vegetables and Fruit	* 0.011 (0.006)	* 0 (0.005)	* 0.019 (0.005)	* 0.016 (0.004)	* 0.01 (0.012)	* 0.011 (0.005)	* 0.025 (0.004)	* 0.016 (0.003)	* 0.013 (0.004)	* 0.023 (0.005)
Other Food	0.016 (0.007)	* -0.002 (0.008)	0.022 (0.008)	0.018 (0.007)	0.025 (0.012)	* 0.002 (0.007)	0.027 (0.005)	0.017 (0.005)	0.014 (0.005)	* -0.001 (0.006)

Table C.2 Florida-Slutsky Model, Parameter Estimates for 11 Regions of Brazil.

Asymptotic Standard Errors in Parenthesis

(*) Parameters not Statistically Different from Zero

Deleted Observations Model

 π_{1j} Matrix

REGION NUMBER 01: RIO DE JANEIRO

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bread	-0.016 (0.005)	0.007	*0.005 (0.004)	*-0.004 (0.004)	*-0.004 (0.005)	*0.009 (0.005)	0.013
Manioc and Beans		-0.024 (0.004)	0.011 (0.004)	*0 (0.004)	*-0.004 (0.004)	*0.005 (0.004)	-0.005
Beef			-0.041 (0.008)	*-0.002 (0.006)	*-0.004 (0.006)	0.023 (0.007)	-0.008
Other Meat				*-0.011 (0.008)	0.014 (0.006)	*-0.008 (0.009)	-0.010
Vegetables and Fruit					*-0.017 (0.010)	0.021 (0.007)	0.006
Other Food						-0.062 (0.012)	-0.013
Food Away							0.017

 π_{1j} Matrix

REGION NUMBER 02: PORTO ALEGRE

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bread	-0.031 (0.006)	*0.001	0.011 (0.004)	0.016 (0.004)	*-0.005 (0.004)	*0.007 (0.006)	0.030
Manioc and Beans		-0.018 (0.003)	*0 (0.003)	*0.003 (0.003)	*0.001 (0.003)	*0.008 (0.004)	-0.006
Beef			-0.022 (0.009)	-0.013 (0.006)	*0.004 (0.005)	0.015 (0.007)	-0.006
Other Meat				*-0.011 (0.007)	*-0.003 (0.005)	*0.003 (0.011)	-0.005
Vegetables and Fruit					*-0.008 (0.007)	*0.005 (0.006)	-0.005
Other Food						-0.049 (0.014)	-0.011
Food Away							0.002

π_{ij} Matrix

REGION NUMBER 03: BELO HORIZONTE

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bread	-0.022 (0.006)	*-0.003 0.000	*0.006 (0.004)	*-0.004 (0.004)	*0.001 (0.005)	0.017 (0.005)	0.017
Manioc and Beans		*-0.008 (0.006)	*-0.006 (0.004)	*0.003 (0.004)	*0.002 (0.004)	0.014 (0.006)	0.001
Beef			-0.039 (0.007)	*-0.001 (0.005)	0.010 (0.005)	0.019 (0.007)	-0.012
Other Meat				-0.018 (0.007)	0.012 (0.005)	*0.01 (0.012)	0.001
Vegetables and Fruit					-0.042 (0.008)	0.015 (0.007)	-0.003
Other Food						-0.092 (0.015)	-0.017
Food Away							0.013

 π_{ij} Matrix

REGION NUMBER 04: RECIFE

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bread	-0.019 (0.003)	*0.002 0.000	*-0.002 (0.003)	*0.005 (0.003)	*0.002 (0.004)	*0.006 (0.003)	0.012
Manioc and Beans		*-0.007 (0.004)	*0.003 (0.003)	*-0.003 (0.004)	*-0.007 (0.004)	0.010 (0.004)	-0.002
Beef			*0.001 (0.005)	*0.006 (0.005)	*-0.004 (0.006)	*-0.007 (0.004)	-0.002
Other Meat				-0.018 (0.008)	*0.008 (0.007)	*0.008 (0.009)	0.006
Vegetables and Fruit					-0.044 (0.011)	0.051 (0.007)	0.006
Other Food						-0.075 (0.009)	-0.007
Food Away							-0.013

π_{ij} Matrix

REGION NUMBER 05: SAO PAULO

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bread	*-0.014 (0.010)	*0.005 0.000	*-0.003 (0.006)	*0.004 (0.008)	*0.001 (0.008)	*0.002 (0.008)	0.009
Manioc and Beans		*-0.01 (0.006)	*0.002 (0.006)	*-0.002 (0.006)	*-0.002 (0.008)	*0.007 (0.007)	0.000
Beef			-0.042 (0.012)	*0.013 (0.010)	0.044 (0.012)	-0.030 (0.010)	-0.016
Other Meat				-0.045 (0.015)	0.027 (0.012)	*-0.024 (0.025)	-0.029
Vegetables and Fruit					-0.086 (0.022)	*0.025 (0.015)	0.008
Other Food						*-0.013 (0.024)	-0.033
Food Away							0.059

 π_{ij} Matrix

REGION NUMBER 06: DISTRITO FEDERAL

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bread	-0.032 (0.005)	0.009 0.000	*0.005 (0.005)	*0.003 (0.004)	*-0.005 (0.004)	0.013 (0.004)	0.025
Manioc and Beans		-0.051 (0.005)	0.022 (0.004)	0.010 (0.004)	0.013 (0.003)	*-0.006 (0.004)	-0.003
Beef			-0.073 (0.009)	0.017 (0.006)	*0.002 (0.005)	0.021 (0.006)	-0.007
Other Meat				-0.050 (0.007)	0.012 (0.004)	*0.004 (0.007)	-0.004
Vegetables and Fruit					-0.041 (0.006)	0.018 (0.004)	-0.001
Other Food						-0.063 (0.007)	-0.013
Food Away							0.003

κ_{1j} Matrix

REGION NUMBER 07: BELEM

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bread	-0.026 (0.003)	0.005 0.000	0.008 (0.003)	*-0.002 (0.003)	*0.003 (0.003)	0.010 (0.003)	0.024
Manioc and Beans		-0.052 (0.005)	0.026 (0.004)	0.013 (0.004)	0.009 (0.003)	*-0.006 (0.004)	-0.006
Beef			-0.082 (0.008)	*0.01 (0.006)	*0.003 (0.004)	0.027 (0.006)	-0.009
Other Meat				-0.035 (0.007)	*0.004 (0.004)	*0.006 (0.006)	-0.004
Vegetables and Fruit					-0.034 (0.005)	0.016 (0.004)	0.001
Other Food						-0.062 (0.007)	-0.009
Food Away							0.003

 κ_{1j} Matrix

REGION NUMBER 08: PORTALEZA

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bread	-0.026 (0.004)	0.010 0.000	0.007 (0.003)	0.009 (0.003)	*-0.002 (0.003)	*0.002 (0.004)	0.025
Manioc and Beans		-0.047 (0.004)	0.014 (0.003)	0.009 (0.003)	*0.001 (0.002)	*0.007 (0.004)	-0.007
Beef			-0.059 (0.005)	0.009 (0.004)	*0.004 (0.003)	0.016 (0.005)	-0.008
Other Meat				-0.050 (0.006)	0.006 (0.003)	0.014 (0.007)	-0.002
Vegetables and Fruit					-0.027 (0.004)	0.016 (0.004)	-0.002
Other Food						-0.061 (0.008)	-0.006
Food Away							0.000

π_{1j} Matrix
REGION NUMBER 09: SALVADOR

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bread	-0.016 (0.003)	0.007 0.000	*0.004 (0.003)	*-0.004 (0.003)	*-0.003 (0.003)	0.008 (0.003)	0.013
Manioc and Beans		-0.024 (0.003)	0.010 (0.003)	*0.002 (0.003)	*-0.004 (0.003)	*0.004 (0.003)	-0.005
Beef			-0.042 (0.006)	*-0.001 (0.004)	*-0.003 (0.005)	0.024 (0.005)	-0.008
Other Meat				-0.012 (0.006)	0.012 (0.004)	*-0.007 (0.007)	-0.011
Vegetables and Fruit					-0.016 (0.007)	0.021 (0.005)	0.006
Other Food						-0.063 (0.009)	-0.012
Food Away							0.017

π_{1j} Matrix
REGION NUMBER 10: CURITIBA

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bread	-0.013 (0.005)	*0 0.000	*-0.004 (0.004)	*-0.001 (0.004)	*0.004 (0.004)	*0.009 (0.005)	0.007
Manioc and Beans		-0.019 (0.003)	*-0.002 (0.003)	0.008 (0.003)	*-0.003 (0.003)	0.016 (0.004)	0.000
Beef			-0.035 (0.007)	*-0.001 (0.005)	*0.009 (0.005)	0.015 (0.006)	-0.019
Other Meat				*-0.006 (0.007)	*-0.007 (0.005)	*0.004 (0.009)	-0.003
Vegetables and Fruit					-0.037 (0.008)	0.021 (0.006)	-0.013
Other Food						-0.073 (0.012)	-0.008
Food Away							0.038

π_{ij} Matrix

REGION NUMBER 11: GOIANIA

	Wheat, Pasta and Bread	Manioc and Beans	Seef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bread	-0.010 (0.004)	0.006 0.000	*0.004 (0.003)	*0.003 (0.003)	*-0.002 (0.004)	*-0.003 (0.004)	0.008
Manioc and Beans		-0.028 (0.005)	0.010 (0.004)	*0.004 (0.003)	*-0.002 (0.004)	*0.001 (0.004)	-0.008
Seef			-0.051 (0.007)	*0.003 (0.004)	*0.002 (0.005)	0.023 (0.006)	-0.010
Other Meat				-0.024 (0.006)	*0.008 (0.005)	0.025 (0.007)	0.017
Vegetables and Fruit					-0.029 (0.008)	0.019 (0.006)	-0.005
Other Food						-0.069 (0.009)	-0.005
Food Away							0.002

Table C.3 Conditional Income Elasticities of the Food Groups for 11 Regions of Brazil
Deleted Observations Model

	RIO DE JANEIRO	PORTO ALEGRE	BELO HORIZONTE	RECIFE	SÃO PAULO	GOIATUBA	DIAMANTINA	BELO	FORTALEZA	SALVADOR	CUIABÁ	BOA VISTA
Wheat, Pasta and Bread	0.77	0.80	0.71	0.76	0.76	0.76	0.84	0.73	0.78	0.78	0.89	0.85
Meat, Poultry and Beans	0.65	0.65	0.84	0.64	0.76	0.66	0.91	0.67	0.66	0.64	0.50	0.69
Beef	*1.01	*1.00	*1.06	*1.08	0.68	0.91	0.91	*1.03	1.19	*1.01	*0.94	*0.99
Other Meat	*0.98	*0.92	0.84	0.84	*1.00	*0.99	*0.99	0.84	0.77	*0.98	*0.94	*0.99
Vegetables and Fruit	*1.01	*0.99	1.19	1.18	*1.06	1.12	1.12	1.34	1.22	1.11	1.11	1.22
Other Food	1.06	*0.99	1.07	1.07	1.09	*1.01	*1.01	1.14	1.07	1.05	*1.03	*1.00
Food Item	1.11	1.27	1.06	1.22	1.10	1.23	1.23	1.17	1.18	1.12	1.22	1.15

(*) Parameters not statistically different from unity.

Table C.4 Unconditional Income Elasticities of the Food Groups for 11 Regions of Brazil
Deleted Observations Model

	RIO DE JANEIRO	PORTO ALAGRE	BELO HORIZONTE	RECIFE	SÃO PAULO	DISTRITO FEDERAL	BRASÍLIA	FORTALEZA	SALVADOR	CAMPESIA	SOMANIA
Wheat, Pasta and Bread	0.51	0.53	0.47	0.50	0.50	0.56	0.48	0.51	0.50	0.59	0.56
Meat and Beans	0.43	0.43	0.55	0.42	0.50	0.43	0.44	0.44	0.42	0.33	0.45
Beef	0.67	0.66	0.70	0.72	0.45	0.80	0.68	0.79	0.65	0.62	0.65
Other Meat	0.65	0.80	0.55	0.55	0.66	0.66	0.56	0.51	0.64	0.62	0.65
Vegetables and Fruit	0.72	0.66	0.79	0.76	0.70	0.74	0.88	0.81	0.73	0.73	0.81
Other Food	0.70	0.65	0.71	0.71	0.72	0.67	0.75	0.71	0.69	0.68	0.66
Food Away	0.73	0.64	0.70	0.81	0.73	0.81	0.77	0.78	0.74	0.81	0.76

Table C.5 Florida-Slutsky Model, Slutsky Price Elasticities.
Deleted Observations Model

FLORIDA-SLUTSKY MODEL							
SLUTSKY PRICE ELASTICITIES							
REGION NUMBER 01: RIO DE JANEIRO							
Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away	
Wheat, Pasta and Bre	-0.18	0.08	0.06	-0.05	-0.04	0.10	-0.14
Manioc and Beans	0.10	-0.34	0.16	0.00	-0.06	0.07	0.07
Beef	0.04	0.09	-0.33	-0.01	-0.03	0.18	0.06
Other Meat	-0.03	0.00	-0.01	-0.08	0.10	-0.06	0.07
Vegetables and Fruit	-0.03	-0.04	-0.03	0.12	-0.15	0.18	-0.06
Other Food	0.03	0.02	0.08	-0.03	0.07	-0.22	0.05
Food Away	-0.07	0.03	0.04	0.06	-0.04	0.07	-0.09

FLORIDA-SLUTSKY MODEL							
SLUTSKY PRICE ELASTICITIES							
REGION NUMBER 02: PORTO ALEGRE							
Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away	
Wheat, Pasta and Bre	-0.29	0.01	0.10	0.15	-0.04	0.07	-0.29
Manioc and Beans	0.02	-0.35	0.00	0.07	0.02	0.14	0.11
Beef	0.07	0.00	-0.14	-0.08	0.03	0.10	0.04
Other Meat	0.15	0.03	-0.12	-0.11	-0.03	0.03	0.04
Vegetables and Fruit	-0.06	0.01	0.05	-0.04	-0.10	0.07	0.06
Other Food	0.02	0.02	0.05	0.01	0.02	-0.16	0.03
Food Away	-0.16	0.03	0.03	0.02	0.03	0.06	-0.01

FLORIDA-SLUTSKY MODEL							
SLUTSKY PRICE ELASTICITIES							
REGION NUMBER 03: BELO HORIZONTE							
Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away	
Wheat, Pasta and Bre	-0.23	-0.03	0.06	-0.04	0.01	0.18	-0.18
Manioc and Beans	-0.03	-0.09	-0.07	0.03	0.02	0.15	-0.01
Beef	0.05	-0.05	-0.33	-0.01	0.08	0.16	0.10
Other Meat	-0.04	0.02	-0.01	-0.16	0.11	0.09	-0.01
Vegetables and Fruit	0.01	0.02	0.10	0.12	-0.44	0.15	0.03
Other Food	0.06	0.05	0.07	0.03	0.05	-0.32	0.06
Food Away	-0.08	0.00	0.06	-0.01	0.02	0.08	-0.06

**FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 04: RECIFE**

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bee	-0.23	0.06	-0.01	0.07	0.00	0.08	-0.20
Manioc and Beans	0.10	-0.26	-0.03	0.06	0.01	0.05	0.06
Beef	-0.01	-0.02	-0.25	0.03	0.09	0.09	0.08
Other Meat	0.07	0.04	0.03	-0.18	-0.01	0.04	0.02
Vegetables and Fruit	0.00	0.01	0.12	-0.02	-0.26	0.14	0.01
Other Food	0.04	0.02	0.05	0.02	0.05	-0.19	0.01
Food Away	-0.15	0.03	0.05	0.02	0.01	0.02	0.02

**FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 05: SAO PAULO**

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bee	-0.16	0.06	-0.03	0.04	0.01	0.02	-0.11
Manioc and Beans	0.08	-0.15	0.04	-0.04	-0.03	0.11	-0.01
Beef	-0.04	0.04	-0.67	0.20	0.69	-0.47	0.25
Other Meat	0.04	-0.02	0.12	-0.42	0.25	-0.23	0.27
Vegetables and Fruit	0.01	-0.01	0.23	0.14	-0.45	0.13	-0.04
Other Food	0.01	0.03	-0.11	-0.09	0.09	-0.04	0.12
Food Away	-0.05	0.00	0.08	0.14	-0.04	0.16	-0.29

**FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 06: DISTRITO FEDERAL**

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bee	-0.10	0.01	0.01	-0.05	0.02	0.10	-0.09
Manioc and Beans	0.00	-0.24	0.00	-0.03	-0.03	0.27	0.03
Beef	0.01	0.00	-0.29	-0.01	0.08	0.09	0.13
Other Meat	-0.04	-0.03	-0.01	-0.07	0.13	-0.02	0.04
Vegetables and Fruit	0.02	-0.03	0.12	0.15	-0.42	0.11	0.05
Other Food	0.03	0.09	0.05	-0.01	0.04	-0.25	0.05
Food Away	-0.04	0.01	0.10	0.02	0.02	0.06	-0.18

FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 07: BELEM

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bee	-0.27	0.05	0.08	-0.02	0.03	0.11	-0.26
MANIOC and Beans	0.05	-0.49	0.25	0.12	0.08	-0.06	0.05
Beef	0.04	0.13	-0.40	0.05	0.01	0.13	0.04
Other Meat	-0.01	0.08	0.06	-0.22	0.03	0.04	0.03
Vegetables and Fruit	0.04	0.12	0.04	0.06	-0.47	0.23	-0.01
Other Food	0.05	-0.03	0.13	0.03	0.08	-0.31	0.04
Food Away	-0.15	0.04	0.06	0.03	0.00	0.05	-0.02

FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 08: FORTALEZA

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bee	-0.25	0.09	0.07	0.08	-0.02	0.02	-0.23
Manioc and Beans	0.08	-0.41	0.12	0.08	0.01	0.06	0.06
Beef	0.05	0.10	-0.44	0.07	0.03	0.12	0.06
Other Meat	0.06	0.07	0.07	-0.37	0.05	0.10	0.02
Vegetables and Fruit	-0.03	0.01	0.06	0.09	-0.39	0.23	0.02
Other Food	0.01	0.03	0.07	0.06	0.06	-0.25	0.03
Food Away	-0.13	0.04	0.04	0.01	0.01	0.03	0.00

FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 09: SALVADOR

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Bee	-0.18	0.08	0.05	-0.04	-0.04	0.09	-0.14
Manioc and Beans	0.10	-0.34	0.14	0.02	-0.06	0.05	0.08
Beef	0.03	0.08	-0.33	-0.01	-0.02	0.19	0.06
Other Meat	-0.03	0.01	-0.01	-0.09	0.09	-0.05	0.08
Vegetables and Fruit	-0.03	-0.04	-0.03	0.10	-0.14	0.18	-0.06
Other Food	0.03	0.01	0.09	-0.03	0.07	-0.22	0.04
Food Away	-0.07	0.03	0.04	0.06	-0.04	0.07	-0.09

FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 10: CURITIBA

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Brc	-0.12	0.00	-0.04	-0.01	0.04	0.08	-0.07
Manioc and Beans	0.00	-0.30	-0.03	0.12	-0.05	0.25	0.01
Beef	-0.03	-0.02	-0.26	-0.01	0.07	0.11	0.14
Other Meat	-0.01	0.07	-0.01	-0.06	-0.06	0.04	0.03
Vegetables and Fruit	0.04	-0.03	0.10	-0.08	-0.42	0.23	0.15
Other Food	0.03	0.05	0.05	0.01	0.07	-0.23	0.03
Food Away	-0.04	0.00	0.11	0.02	0.07	0.05	-0.21

FLORIDA-SLUTSKY MODEL
SLUTSKY PRICE ELASTICITIES
REGION NUMBER 11: GOIANIA

	Wheat, Pasta and Bread	Manioc and Beans	Beef	Other Meat	Vegetable and Fruit	Other Food	Food Away
Wheat, Pasta and Brc	-0.12	0.08	0.05	0.03	-0.02	-0.04	-0.10
Manioc and Beans	0.06	-0.26	0.10	0.03	-0.02	0.01	0.08
Beef	0.03	0.07	-0.33	0.02	0.01	0.15	0.06
Other Meat	0.03	0.04	0.03	-0.24	0.08	0.24	-0.17
Vegetables and Fruit	-0.02	-0.02	0.02	0.08	-0.29	0.18	0.05
Other Food	-0.01	0.01	0.08	0.09	0.07	-0.25	0.02
Food Away	-0.05	0.05	0.05	-0.10	0.03	0.03	-0.01

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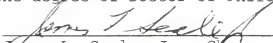
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✦


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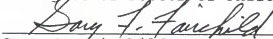
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